EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

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SECONDARY BEAMS FOR TESTS IN THE PS EAST EXPERIMENTAL AREA

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TABLES

FIGURES

1. INTRODUCTION

This report gives a description of the four secondary beams used in the PS East Experimental Area for testing experimental apparatus.

Section 2 gives some information on the layout of the beams, whose main parameters are given in Section 3.

Part 4 is a short handbook, where the future users will find some practical information on the equipment available (beam monitoring, targets, etc.) and (hopefully !) will find some help to operate the beams.

2. GENERAL LAYOUT IN THE EAST AREA

A general view of the beams is shown on Figure 1.

The primary proton beams, the four secondary beams themselves and the associated shielding, huts, etc. cover about 2000 m2 (half the East Hall area), the downstream part being used for other purposes.

2.1 Primary Beams

The test beams are derived from the slow-extracted proton beam FT61, ejected from the PS straight section 61.

This extracted beam, called primary beam, is split in two branches, e17 and e17-South, which feed two production targets, sources of the four secondary beams.

The splitting is obtained by means of a special iron septum D.C. magnet (SMH01) with a vertical field, located on the extracted beam at an horizontal waist where the beam is vertically expanded. The gap and the vertical position of the splitting magnet may be adjusted by remote control from MCR.

It is possible to adjust the number of protons hitting the two production targets, by playing with the intensity, with the optics of the extracted primary beam, and also with the splitter parameters.

The main parameters of the primary beam are given in the following table.

TABLE 1

Characteristics of the primary beam
(slow extraction SE61)

Type of particles	protons
Momentum	24 GeV/c
Typical beam spill length	300 to 400 msec
Typical repetition rate	1 to 2 spills in 14.4 sec PS "super-cycle"
Minimum repetition time	2.4 sec ("B cycle")
Maximum proton intensity on each target	$2x10^{11}$ particles/pulse *)

*limited by the radiation level in the downstream part of the East Hall.

2.2 Secondary beams

Figure 2 gives a schematic layout of the secondary beam lines with indication of projection and space production angles.

The North target (primary beam branch e17) is the source of the three secondary beams T9, T10 and T11 produced at different horizontal and vertical angles.

The South target (primary branch e17-South) is the source of the T7 beam : 0°(production angle.

In order to make possible the testing of large equipment, the north beam is bent upward by 30 mrad in the primary line. By using different vertical production angle, it has been possible to increase the beam to floor clearance such that the beam level above the floor is now :

- 2.32 m in T9
- 2.50 m in T10 and T11

The T7 beam, previously used for physics, is at 1.28 m above floor level.

3. BEAM PROPERTIES

3.1 Optics

The four beams*) are designed in order to provide the users with momentum analysed, non-separated secondary particles (momentum resolution of the order of 1%), positive or negative polarity. They are intended to be used as test facilities for experimental apparatus.

The polarity, momentum, intensity and momentum bite may be adjusted inside a large range up to the nominal values. The experimental areas are large enough to house more than one user's apparatus at a time.

Each beam consists of two focusing stages (double monochromator) :

- the first one (two quadrupoles and a bending magnet) performs the momentum analysis at a variable-aperture horizontal collimator (MCH01, "momentum slit"). A vertical collimator MCV01 may be used to adjust the beam intensity :
- the second one performs the momentum recombination (use of a "field lens") and refocuses the beam into the experimental area.

The final focus may be moved along the area by changing the currents in the last quadrupole doublet ; steering dipoles are available in order to adjust the beam position (horizontal and vertical).

The beams are equipped with detectors (multiwire-proportional chambers, Cerenkov counters).

The necessary signals and equipment for beam tuning are available in EBCR (East Beam Control Room, EP 27). More details are given in Section 4.

*) The t7 beam was built for the experiment PS188 (channelling)

3.2 Intensities

The following section gives the intensity estimations in the beams for p^+, π^+, π^-.
In general, the numbers given are based on computations ; some of the measurements made by users are reported.
As far as electrons (or positrons) are concerned, we have a good knowledge at zero degree production angle (T7 and T9 beams). Some measurements in the T11 beam are also reported.

The secondary fluxes are calculated from :

$$N_s = N_p \eta \, \Omega \, \Delta p \, Y_i \, e^{-L/\lambda i}$$

where

N_p = Number of protons impinging on the production target

η = Target efficiency

Ω = Solid angle of the beam (Steradian)

Δp = Secondary momentum bite (GeV/c)

Y_i = Yield for the particle i

L = Beam length (metres)

λ_i = Decay length for the particle i (metres).

The product $N_p . \eta$ represents the number of protons interacting in the target.

The target efficiency η depends on many factors, such as target length and material, particle type and momentum. As far as our beam lines are concerned, we use the η values measured for pions produced by external targets[1)]. The mean values used for the computations $(0.1 \leq \eta \leq 0.35)$ are shown on the plot of Fig. 3. These η values together with the yields Y_i given by Sanford and Wang [2)3)], give computed pions fluxes which are in good agreement with the measured values (for example : beam c13, [4]), similar to the beams T7 and T9).

The computed intensities at the end of each beam (p^+, π^+, π^-.) are given on the figures in the last part of this report. As an example, we have also computed the fluxes of K^+, K^- and $\overline{p}$ which may be found at the end of the T9 beam (these results may be used as an order of magnitude for the other beams).

The fluxes of electrons (or positrons) are estimated from the computations of R. Beckman [5]. The yields are calculated by Monte-Carlo simulations of the different processes involved, the predominant one being pair production from gammas produced by π^0 decay inside the target.

Two important results are shown on Figs. 4 and 5.

- Figure 4 shows the electron component of a beam produced at zero degree versus the particle momentum. Some experimental data are shown together with the computed curve ; both confirm a drastic reduction of the electron percentage when the beam momentum increases.

- Figure 5 shows the computed effect of the production angle on the electron yield : at 55 mrad (about the production angle of the beam T10) the electron yield is four times smaller than at zero degree at 1 GeV/c, and drops when the momentum increases.

These effects are confirmed by the measurements performed in 1987 by the UA2 team in the beam T11 (angle of production 150 mrad). The results shown on Fig.28 compared to those at a zero degree production angle (see for example Fig. 4) confirm the very important diminution of the electron component in a beam when the angle of production increases.

3.3 Beam parameters (T7, T9, T10, T11)

The main characteristics of the beams are given in the following way. For EACH beam, we give at the end of this note the following tables or figures :

- a table of parameters
- a table which gives the nominal value of the currents in the transport elements as a function of the beam momentum
- the optics

- two figures which show how to move the beam focus along the beam line in the users' area, together with the relative increase of the spot-size (results of computations).
- the calculated intensities versus beam momentum
- the intensity measurements (if any).

Note that there are two different lines for the beam T7 : The South one, with a full compensation of the chromatic dispersion at the end of the beam, and the North one, not compensated and which gives always a large beam size in the horizontal plane (spatial dispersion).

Beam T7 : see pages 29-29
Beam T9 : see pages 40-46
Beam T10 : see pages 47-52
Beam T11 : see pages 53-59.

The T9 experimental area has been extended : a second area is available behind the first one (called T9E, see Fig. 1) with a separate door and beam stopper.

3.4 Irradiation facility

In some cases, higher intensities are requested by the users ; for this purpose, a special area has been prepared. This small area in visible on Fig. 1, at the upstream part of the beam T7 (ZT7), between the bending magnet BHZ01 and the dump of the primary proton beam. A special TV screen, named MTV10, has been installed a few meters downstream of the target (MTV09) in order to tune the primary beam in this area.

Irradiation of material is possible in this area under different conditions :

- as "only user" (no target for T7), proton intensity in the range $10^9/10^{11}$ per second are possible at 24 GeV/c.
- as parasitic user of the beam T7 (target in the primary beam) intensity below 10^{11} is still possible (degraded primary protons and secondary particles).

The access to this area is possible only when primary beams are stopped. For small pieces of equipment, the access is possible via the normal access door 152 ; for big or heavy pieces, an access by the top of the shielding has been prepared. The time necessary to introduce a heavy piece of equipment by opening the shielding is at least half a day (all beams stopped).

3..5 Very low intensities

Some users ask for very low intensities : the area called T9[1] receives very low flux of muons coming from the target of T7. The access to these areas are possible via the stair cases (no doors), see Fig. 1.

4. SHORT USER'S GUIDE

4.1 Targets available

As explained before, the primary beam is split in two branches. The target used by the beam T7 is visible on Fig. 1 at the position MTV09 ; the common target for the beams T9, T10 and T11 is at the place MTV07. The users of these three beams have to agree on the use of a common target.

The targets are mounted on a remotely controlled mechanism. Ask the PS Main Control Room (MCR) in order to change the target.

Tables 2 and 3 give the list of the targets available on request.

4.2 Standard detectors

Each test beam of the East Hall (ZT7, ZT9, ZT10, ZT11 in computer names) is equipped with some detectors in order to facilitate its setting-up or to provide beam diagnostic during operation :

- Multi-wire proportional chambers (MWPC) ;
- Cerenkov counters (CER) ;

Their positions in the beams are shown on the drawing "East Hall floor plan" (Fig. 1, available from Mrs. G. Granger, PS, Tel. 2009).

The output signals produced by the Standard Detectors are collected in the East Beam Control Room of the test Hall located in barrack EP27A (door A) for all beams. Electronics is located in a row of racks (see Fig. 6).

- The Standard Detectors are essential for operation. Therefore, the users should never remove them from the beam line.

TABLE 2

List of targets available for the beam T7

1	ZnS	Screen
2	Al	ϕ 3x50 +W ϕ 20x3 **
3	Cu	2.5x150 (square section)
4	ZnS	screen (no graduation)
5	Al	ϕ4x190
6	Al	ϕ 4x190
7	ZnS	screen
8	Al	ϕ3x125 + W ϕ 20x3 **
9	Al	ϕ 5x250 *
10	A1203	screen
11	BeO	ϕ 4.3x240 *
12	Passage	(for primary beam irradiations)

* normally used for maximum yield

** special targets : aluminium bar followed by a tungsten converter

N.B. a) dimensions are in mm
ϕ 3x150 = diameter 3 mm
= length 150 mm

b) Control of the targets : PS Main Control Room (MCR, Tel. 6677).

TABLE 3

List of targets available for the beam T9, T10, T11
(common target)

1	ZnS	Screen
2	Cu	ϕ 4x25
3	Cu	ϕ 4x50
4	Be	ϕ 5x200 + W ϕ 20x3 **
5	Al	ϕ 5x150
6	Al	3x5x100 + W ϕ 10x3 **
7	ZnS	screen
8	Cu	ϕ 4x100
9	Al203	screen
10	Al	ϕ 5x250 *
11	Al	ϕ 5x200
12	Al	sheet ϕ 80x1mm thick

* normally used for maximum yield

** special targets : aluminium bar followed by a tungsten converter (more electrons)

N.B. a) dimensions are in mm

ϕ 5x150 = diameter 5 mm

= length 150 mm

3x5x200 = vertical 3mm, horizontal 5 mm, length 200 mm

b) Control of the targets : PS Main Control Room (MCR, Tel. 6677).

4.2.1 Cerenkov Counters (CER)

Each secondary beam is equipped with one or two threshold Cerenkov Counter (CER). Its length and position in the beam is shown on Fig. 1. Its mechanical characteristics are shown on drawing EP 82.550. The upstream and downstream windows are made of Mylar sheets, thickness 0.6 mm each. The CER may be filled with non-flammable gases, e.g., CO2, He, Ar, N2.... to a maximum overpressure of 3.3 bars (0.33 MPa). The gas bottles, if not left over from previous run, must be provided by the beam user ; they can usually be purchased from the CERN gas store. The filling panels and gas bottles are located outside of the test areas, the Gas Distribution Rack (GSD) is located next to the Beam Control Room EBCR.

The synoptic scheme engraved on the front panel of the GSD indicates the order of the operations. The user must proceed according to the rules fixed by the CERN GENERAL SAFETY CODE.

When changing the filling, make sure no overpressure is left, open the leak valve ("FUITE") before switching ON the vacuum pump. Flushing the counter several times after ten minutes pumping is more effective than pumping a long time.

All CER installed in the East Hall have been fitted with UV sensitive PMs model XP2020Q. The HT should never exceed 2 kV, the power supplies are in E BCR. Every user should run his own signal cable to the CER. If both outputs are used, make sure they are properly terminated.

4.2.2 Multi-wire Proportional Chambers (MWPC)

There are two MWPC in each secondary beam : - MWPC01 is located next to the last magnet in the beam line ; - MWPC02 is located at the reference focus of the beam (see Fig. 1). Each MWPC provides the horizontal and vertical profiles of the beam. The signals' outputs of the MWPC are sent to the Beam Control Room where they are processed by some electronics (integrators + μP controlled display unit) and then displayed on TV monitors. In addition to the beam profiles other information like size and beam position are given. However, no other information can be obtained from the MWPC about the physical properties of the beam. If desired, the profiles displayed on the TV monitors of the Beam Control Room can be sent to the beam users hut. The HT voltage and the gas flow necessary to supply the MWPC are set at the beginning of a run and should need no further adjustment. The MWPC to be displayed should be selected on rack 5 (see Fig. 6).

4.2.3 MWPC settings

The MWPC are not under control of the workstation and should be set manually. They are located in rack #5 in which you can find, from top to bottom :

- a TV monitor where the profiles will be displayed.
- the high voltage sources for the MWPC, from C.A.E.N.
- the unit selector, set of switches, labelled with the MWPC location and #
- some more hardware.

Select the MWPC you need to monitor on the switch box. Make sure that only one is selected at a time). If needed, trim its supply voltage on the same channel number on the C.A.E.N.

Assuming you are working on channel 4, under the following conditions :

- operating voltage	:	1750V	(V0)
- maximum voltage	:	2400V	(V1)
- max normal current	:	8mA	(I0)
- trip current	:	12mA	(I1)

and the channel is not currently selected and has never been set, you should type on the front control panel : (recommended sequence, each command needs only be entered once; the '#' key terminates a numerical entry since the apparatus uses free format numerical representation.)

- F0#4#	select channel 4
- F5#2400#	set trip voltage V1 at 2400V
- F3#12#	set trip current I1 at 12mA
- F2#8#	set maximum normal current I0 at 8mA
- F1#1750#	set operating voltage V0 at 1750V
- F10#	set selected H.V. channel ON

you can then alter the voltage using the F1#volts# or the ramping functions.

<u>Warning :</u>

If the safety values I1 and V1 are not properly set, the channel will usually trip when set ON. In this case check the values, alter them if necessary.

<u>Remark :</u> Scintillation counters for beams definition have to be provided and installed by the user.

4.2.4 Slits

The reading gives the distance in mm from the beam axis for the right and left/upper and lower jaws. Positive values are towards the outside ; negative value indicates that the inner edge of the absorber jaw is beyond the axis on the opposite side.
A setting of 3.5/3.5, for a total aperture of 7mm gives the best available momentum resolution of about 1%. A wider momentum slit increases the intensity but reduces momentum resolution while a narrower slit will decrease the intensity without further improvement in momentum spread.
Slits less than about 2mm wide create a significant halo of slightly off-momentum particles, thus reducing beam definition.
For beam tuning, using the installed MWPC, the momentum slit should be 3.5/3.5 and the aperture slits not less than about 10 mm total width.

4.3 Timing signals.

They are now dispatched from EBCR to every physics counting room and are available from a wall mounted grey box fitted with five BNC connectors.
Signals are standard PS timing pulses of 24V amplitude and 1 μs duration.
Standard timing distribution is as follows (left to right)

- 1 : Extraction warning
- 2 : C cycle warning (generate high RF noise)
- 3 : SEC1 (primary line intensity upstream of the splitter)
- 4 : SEC2 or SEC3 (intensity in north or south branch, upstream the target)
- 5 : TEL2 or TEL3 (transverse look at the target).

4.4 Setting of magnet currents

This is under control of a DEC3100 workstation located in EBCR. Nominal settings in function of momentum can be found in the tables describing each line. Assuming the workstation is up and running :

- select your line from the page 1 menu, this activates a synoptic displaying the line elements with their current state and setting.
- select one or several magnets by clicking on the yellow (right) rectangle, this displays a control panel for the selected magnet :
    - left (yellow) switch. Current setting : the current can be adjusted by :
        - clicking on +/- or dragging the cursor in the ammeter
        - typing in the setting value after having selected the input field (red rectangle)

- right (brown) switch : general commands and status (ON, OFF, STANDBY, FAULT)
  - action is effected by just clicking on the proper label.

Avoid too many windows at once, as it slows down the machine and clutters the display.

It is possible to save current settings or to recover previously saved ones by using the 'ARCHIVES' button on page 1. The settings for all the lines are saved at once; for recovery, 'restore with filter' should be used, selecting the line you are working on.

Workstation start-up.
If the program is not already running (empty screen), log in with user and password as indicated in the operation handbook (in the control room).
The program is self-starting at logon.

More information on the use of the workstation as well as hints for troubleshooting may be found in the operational handbook which will be kept up to date in the beam control room (EBCR).

4.5 Problems

If no beam is detected after a correct set-up, please follow this check-list :

- check for beam in the primary area on MSC, if not, ask MCR ;
- check for beam hitting the target (telescope counter), action MCR ;
- check the beam stopper is OPEN (status available in EBCR, rack #1 and at the beam door). If a VETO status exists, ask MCR to cancel it ;
- check all magnets in your line are ON and at their proper current and polarity (on the workstation) ;
- check the collimators, the opening should never be less than a few mm and should be symmetric around the beam axis (same reading on both jaws) ;
- if there is some counting on the MWPC, but no visible spot :
  - increase the MWPC voltage using the C.A.E.N. supply ;
  - steer the beam using the last horizontal and the vertical dipoles.

If something fails to check, call :

MCR	phone 6677	first 3 points
Piquet PO	beep 3005	magnet or power supply
Beam specialist	phone 2630, beep 3138	
or	phone 6908, E-mail : dur@cernvm.	

RADIATION SAFETY IN
THE PS EXPERIMENTAL AREAS
(version française au verso)

RADIATION SAFETY 87/1
JF/fp - 12.05.987

- Prepared by T.S.O.: K. Bätzner
- Approved by R.S.O.:

ACCESS CONTROL FOR THE EAST HALL SECONDARY BEAM ENCLOSURES

ENTRY

1. Keep button (1) pressed whilst removing a key from the store. Each person entering must take a key.
   THIS KEY IS YOUR GUARANTEE OF SAFETY and should remain in your possession during your stay in the closed area.
2. When "Accès possible" lights up (indicating beam stopper closed), keep button (2) pressed whilst opening door.

EXIT

1. Open door whilst pressing button (3).
2. Replace key in store.
3. When all keys are in the store, the beam stopper may be opened (*).
   It is the responsibility of the person replacing the last key to ensure that no one is left inside the enclosure.

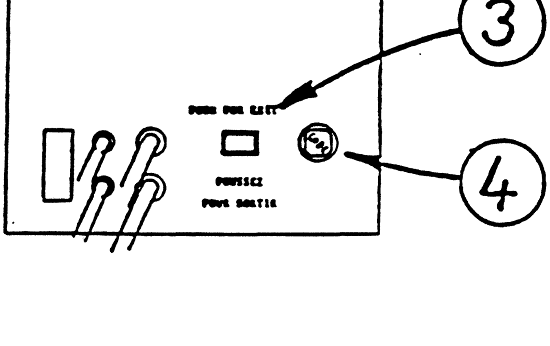
FREE ACCESS (during installation)

If one of the keys from the store is placed in position (4) inside the door, the lock will be released (and the beam stopper cannot be opened).

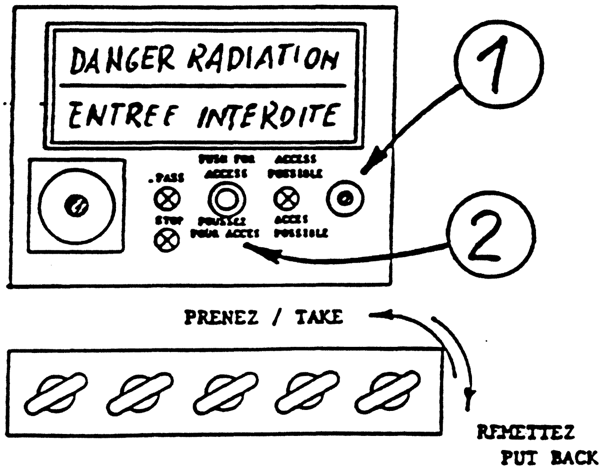
RESPONSIBILITY

- It is the responsibility of the experimental team(s) using the beam to follow ONLY the procedure described above for access to the enclosure.
- Film badges should be worn at all times in the East Hall.

(*) After modifications to the beam or enclosure, or a machine stop, the Main Control Room will lift the veto on beam stopper opening when requested, providing security conditions and the enclosure walls are in order.



interior



exterior

SECURITE RADIATIONS DANS
LES ZONES EXPERIMENTALES DU PS
(english version overleaf)

SECURITE RADIATIONS 87/1
LD/fp - 12.05.1987

- Préparé par T.S.O.: K. Bätzner
- Approuvé par R.S.O.:

PROCEDURE D'ACCES AUX FAISCEAUX SECONDAIRES DU HALL EST (bât. 157)

ENTREE

1. Appuyer sur le bouton (1) et simultanément prendre une clé et la garder. Toute personne qui entre doit prendre une clé. CETTE CLE EST VOTRE GARANTIE DE SECURITE.
2. Quand la lampe "Accès possible" est allumée, (le beam stopper est fermé), appuyer sur le bouton (2) et ouvrir la porte.

SORTIE

1. Appuyer sur le bouton (3) et simultanément pousser la porte.
2. Remettre la clé dans le distributeur.
3. Si toutes les clés sont en place dans le distributeur, le beam stopper peut être ouvert (*). La personne qui remet la dernière clé doit vérifier que personne ne reste dans la zone.

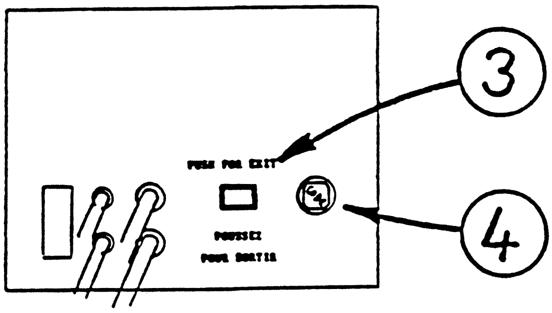
ACCES LIBRE (en périodes d'installation)

Une des clés placée en position (4), à l'intérieur de la porte, permet un accès libre (impossibilité d'ouvrir le beam stopper).

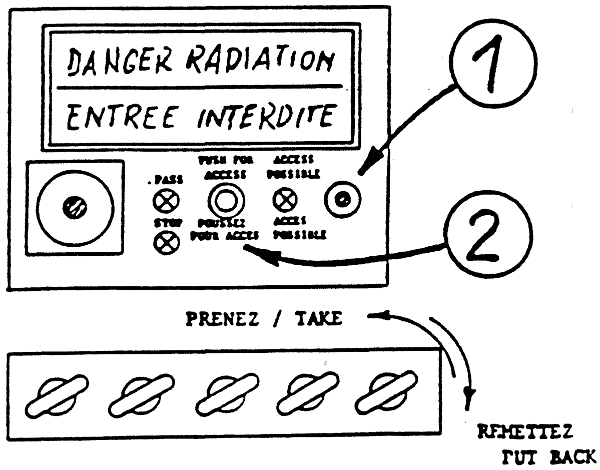
RESPONSABILITE

- L'application de CETTE PROCEDURE, à L'EXCLUSION DE TOUTE AUTRE, est sous l'entière responsabilité des utilisateurs.
- Tout utilisateur doit porter son film badge dans le hall.

(*) Après un arrêt ou des modifications, la Salle de Contrôle principale (MCR) enlèvera le "veto" du beam stopper sur demande des utilisateurs si les conditions de sécurité et les murs d'enceinte sont en ordre.



interieur



exterieur

CPS-OPERATION 1993 PERIOD 1 WEEK 10/11/12/13/14 MARCH 8 /APRIL 8 - PSO 1101

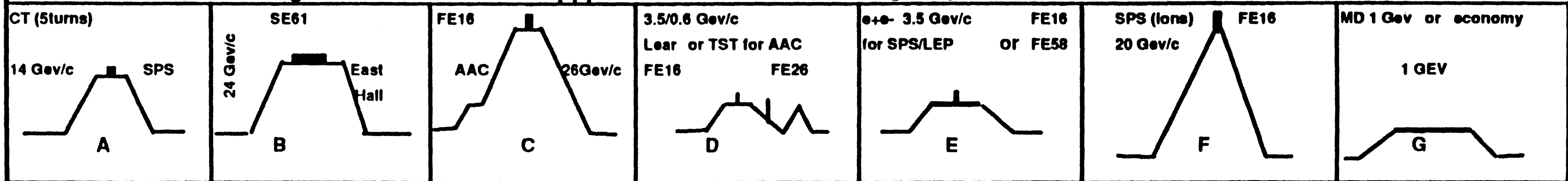
This schedule is definitive at time of publication. For later changes or access conditions, please call the MAIN CONTROL ROOM 6677

8h 17h 8h 8h 6h 8h 8h 8h 8h 6h 12h 24h

March / April	Wk. 10	Wk. 11	Wk. 12	Wk. 13	Wk. 14
	Mon Tue Wed Thu Fri Sat Sun	Mon Tue Wed Thu Fri Sat Sun	Mon Tue Wed Thu Fri Sat Sun	Mon Tue Wed Thu Fri Sat Sun	Mon Tue Wed Thu Fri Sat Sun
	8 9 10 11 12 13 14	15 16 17 18 19 20 21	22 23 24 25 26 27 28	29 30 31 1 2 3 4	5 6 7 8 9 10 11
PS SUPERCYCLE		C	2A C B C 2D B	2A C B 2D 4E	See MD Sch / 2A C 2D C 2E C
PS		SU			MD
SPS/LEP Faugler			SU with protons		MD / EASTER SHUT DOWN
LPI/ Frammery	RF Tests		Equip. Tests / SU	Leptons to PS	MD
LINAC2/ PSB Tetu / Wildner	Linac start up with new contols	SU PSB			ME
AAC Baird / Chohan	Equipment Tests		Start up with TST		
LEAR Baird / Chanel		SU with protons		MD	
East Hall t7 Clark / Suffert			SU		
East Hall t9 Williams/Ypsilantis/Rancoita/RD30			SU		
East Hall t10 OPAL/WA95			SU		
East Hall t11 PS202/RD26/Palombo			SU		

Intensities E17 : Each target no more than 2 E11 ppp

Magnet cycles :



A[104]= 14Gev/c-1.2s. B[161]=24Gev/c-600ms-2.4s C [201]=3.5/26.3Gev//c 2.4s D [66]=3.5/0.6Gev-1.2s E [21]=3.5Gev/c - 1.2s F[103]= 20 Gev/c - 1.2s G[31]=1 Gev - 2.4 s

Editors : J.Boillot tél.3179 / D. Dagan tél. 2901

OK for publication : N.Hamann/J.Boillot

11/03/93 13:58

RADIATION SECURITY

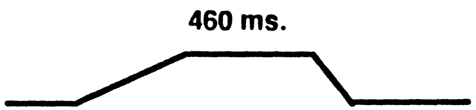
Exact conditions in a given Experimental Aera depend upon beams in use, etc..; further details can be obtained from the MCR . - Les conditions exactes pour une zone d'experience donnée dépendent des faisceaux utilisés, etc...; de plus amples détails peuvent être obtenus à la MCR.

PS OPERATION

Ejection example	[SE 61 :	slow resonant extration from straight section 61
	[CT :	continuous transfer process to SPS
	[FE 16 :	Fast extraction from staight section 16

PS MAGNETIC CYCLE :

Notation : 24 GeV/c - 460 ms - 2.4s

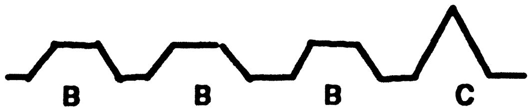


2.4 second repetition rate.

Notation: 10 GeV/c - 1.2 s.

1.2 second repetition rate.

SUPERCYCLE: Groups of cycles . Example :



BBBC,BBBC,....

MACHINES and BEAMS LINES

(open box)	Beam ON or Beam transport for beam line e15 energized
(hatched box)	Beam OFF or Beam transport available
SU	Setting up
ME	Machine Experiment

MD	During this period, mode of operation and beam utilization are specified in a Machine Development programme available in the MCR.	Durant cette période l'utilisation des accélérateurs et des faisceaux est spécifée dans le programme de MD qu'on peut consulter au MCR.

CPSOP-1993: ***The 4 week PS Operation Schedule is now available in the PS Network, select "PS-Division", then "4 Week Schedule".***

Distribution PS 10 List.
and as requested to : Mrs. D. Dagan tel. 2901

REFERENCES

1) MPS/Int. MU/EP 68-5, 5.7.68, Efficiency of external targets.
L. Hoffmann and H. Schönbacher.

2) JRS/CLW1 and JRS/CLW2, 1967, (Brookhaven National Laboratory), Empirical formulae for particle production in p-Be collision between 10 and 35 GeV/c.
J.R. Stanford and C.L. Wang.

3) BNL-22452, 25.1.77, Low energy kaon and antiproton production in p-Be collision between 10 and 30 GeV/c.
C.L. Wang.

4) PS/MU/BL/Note 81-7, 23.10.81, The c13 beam.
K. Bätzner, M. Chassard, D. Dumollard, D.J. Simon.

5) PS/MU/EP/Note 82-13, 14.10.82, Electron yield from p-N collisions.
R. Beckmann.

6) Nuclear Physics B254-491/527, 1985, Channelling radiation from 2 to 55 GeV/c electrons and positrons.
J. Bak, E. Uggerhoj et al.

7) Thesis (Aarhus Universitet), May 1984, An experimental investigation of channeling radiation produced by 2 to 55 GeV/c electrons and positrons.
J.F. Bak.

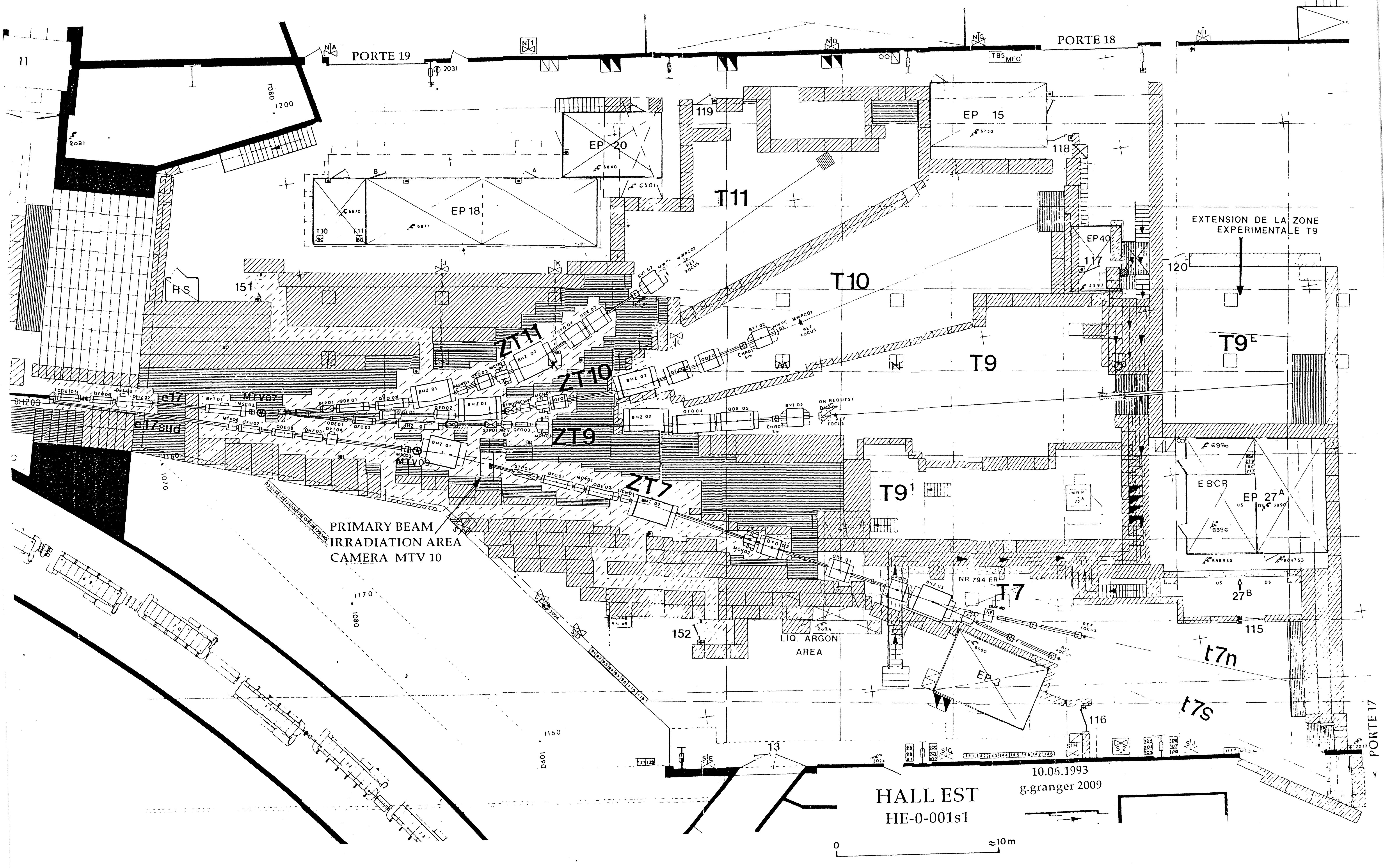
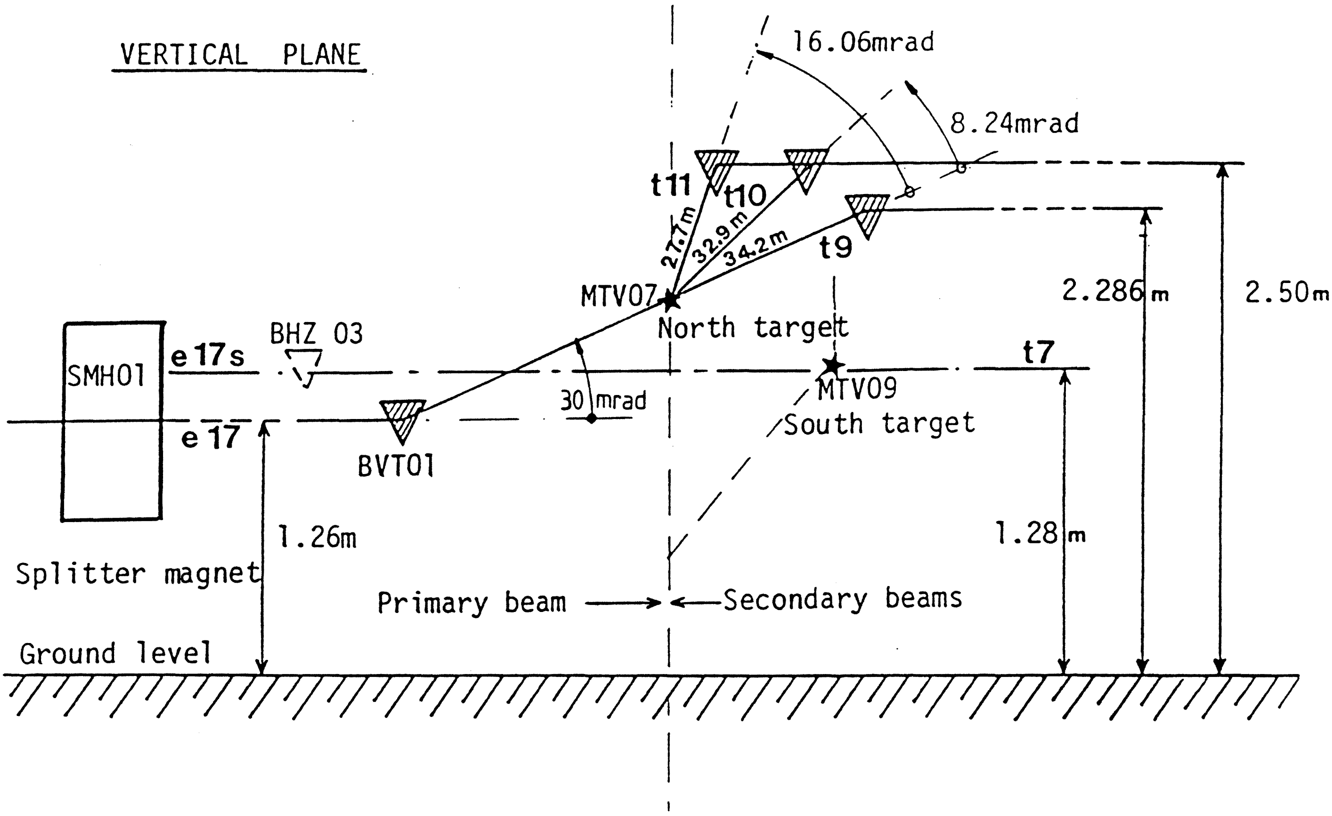


Figure 1 : East Hall floor plan



Production angle

$\theta_{t7} = 0^0$

$\theta_{t9} = 0^0$

$\theta_{t10} = 61.6\text{mrad} = 3,53^0$

$\theta_{t11} = 149.2\text{mrad} = 8.55^0$

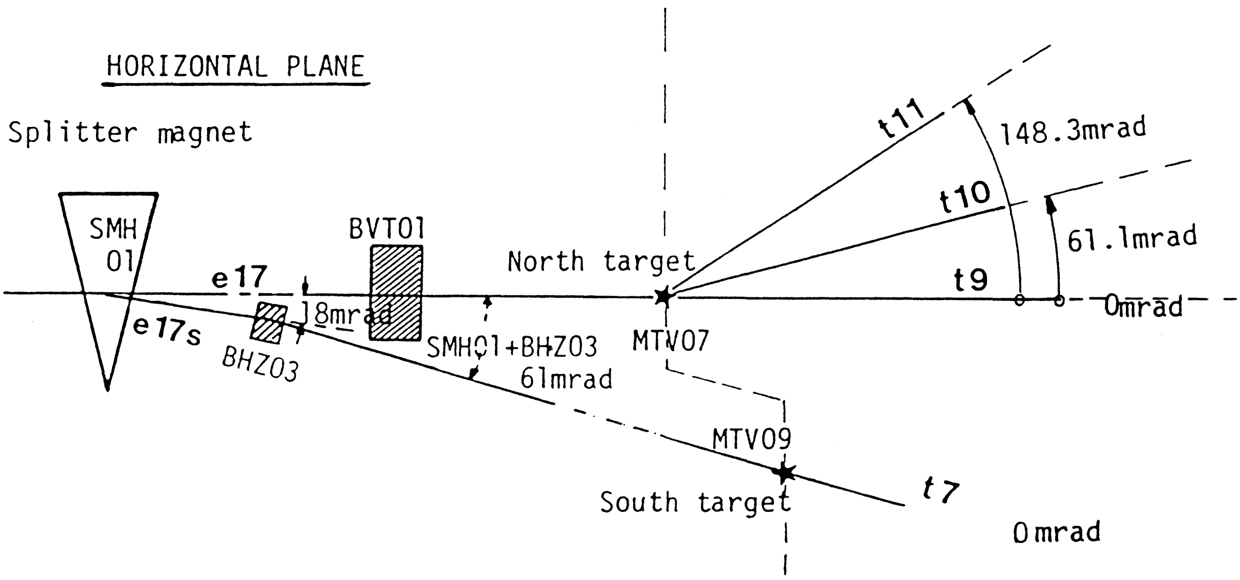


Fig : 2 Schematic layout of the secondary beams

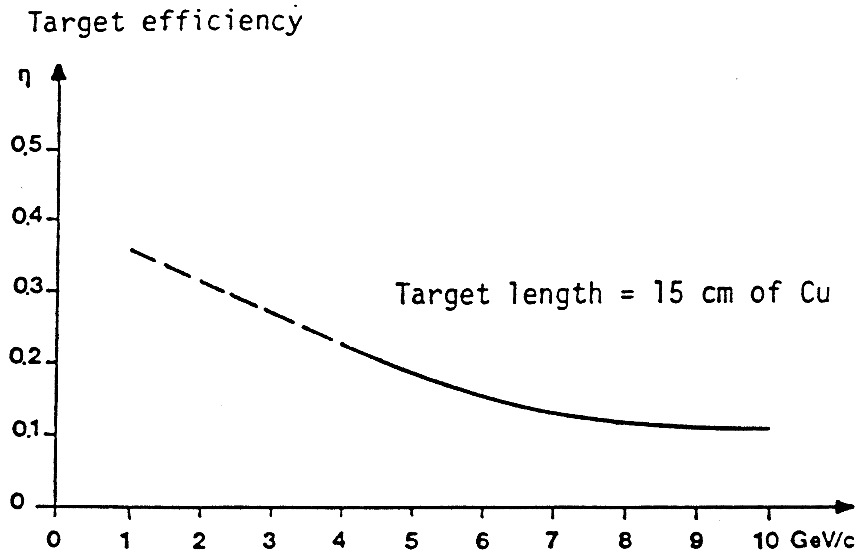


Fig 3.
Estimated target efficiency versus beam momentum
(from Refs. 1 and 4)

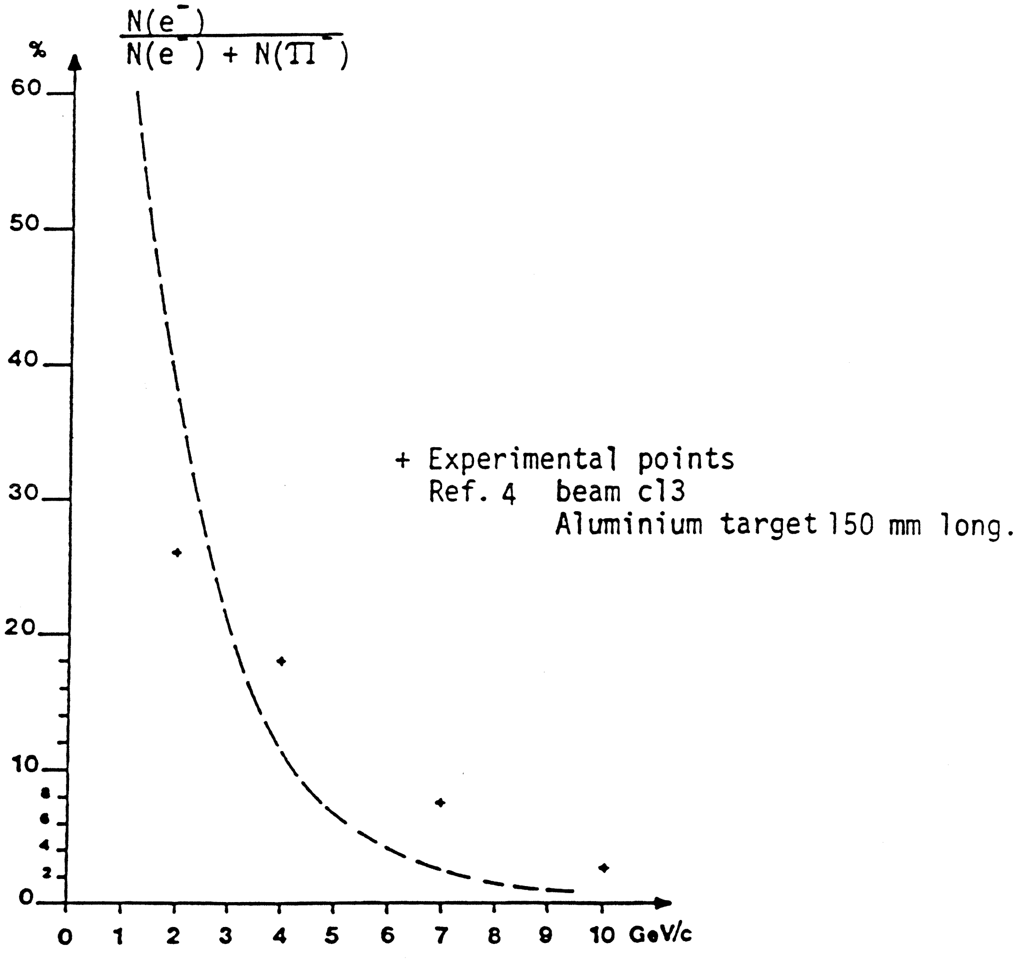


Fig 4.
Percentage of e^- in a negative beam calculated in Ref. 5
(zero degree production angle).

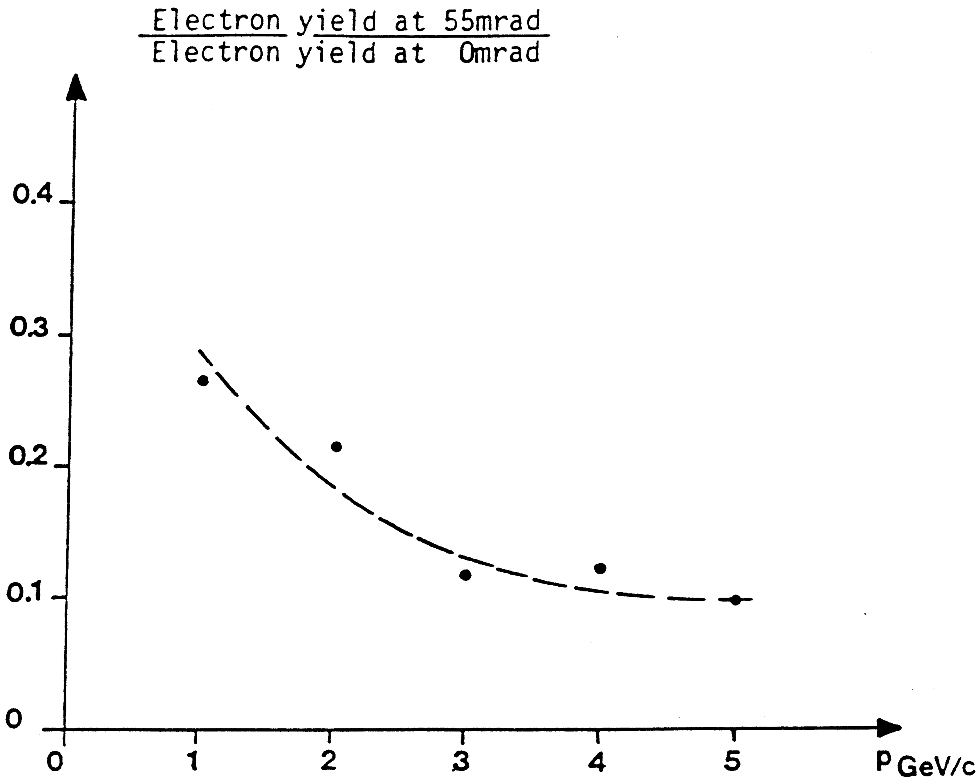
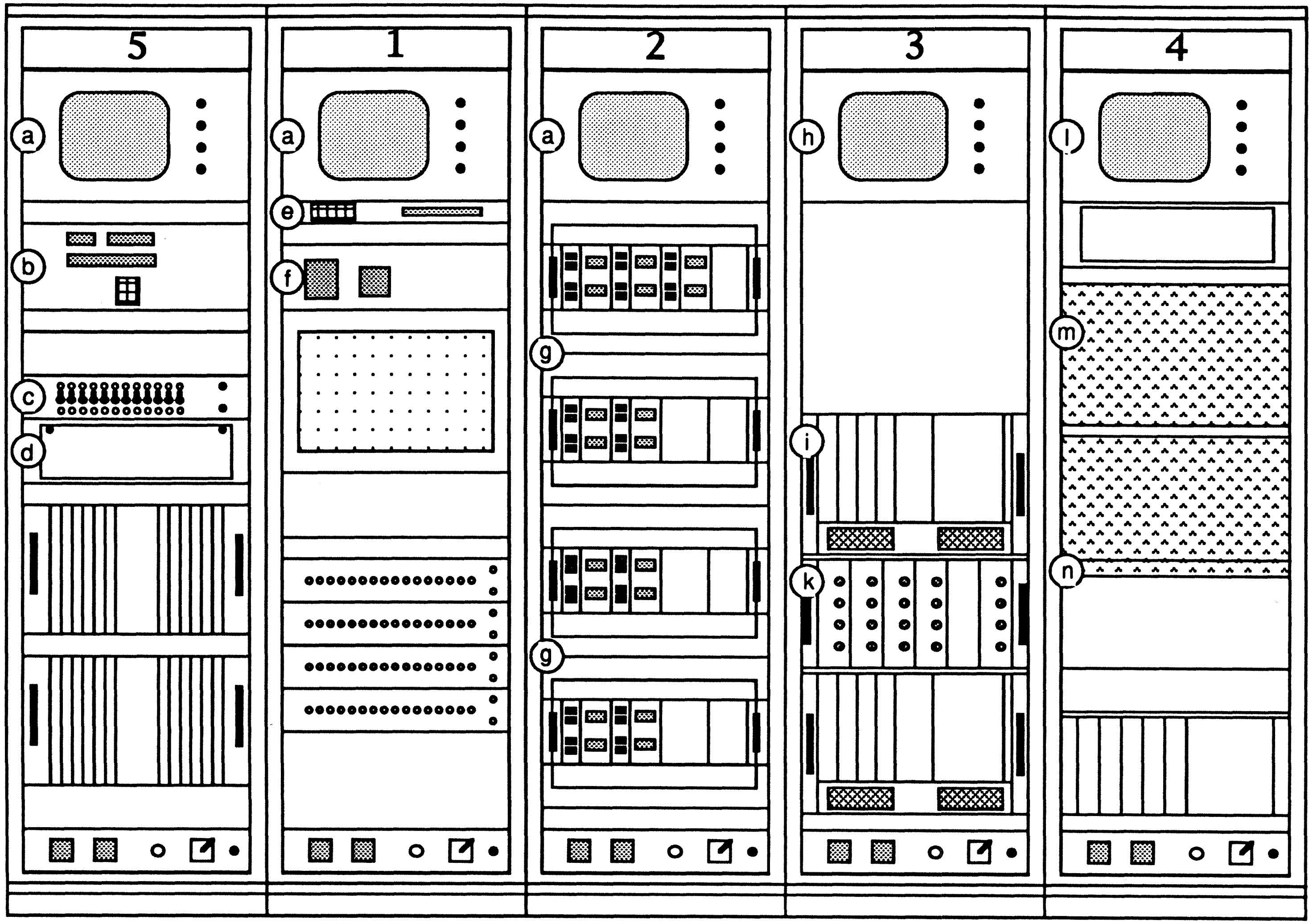


Fig 5.
Effect of the production angle on electron (positron) yield
(from computations in Ref. 5)

Racks-Layout in EBCR

Rack N°



Equipment

a - beam profile: MWPC-display

b - HT setting for MWPCs (CAEN)

c - MWPC selection

d - MWPC readout controller

a - beam profile: MWPC-display

e - PS beam intensity

f - Test-Area door- and beam-shutter status

a - beam profile: MWPC-display

g - slits control (aperture and momentum) for T 7, T 9, T 10, T 11

h - Test Area permanent beam monitors display

i - 12-channel Scaler, display is on monitor next to consoles for beam control

k - HT for Cerenkov counters

l - PS cycle display and information

m - patch-pannel for 50 Ω pulse- and 75 Ω video lines to users huts

n - video source selection for desk-monitor

Fig. 6

TABLE 4

CHARACTERISTICS OF THE BEAM t7

Maximum design momentum (GeV/c)	10	
Length at reference focus[1] (m)	45	
Beam height (m)	1.28	
Production angle (H	---	
(mrad) (V	---	
(total	0	
Angular acceptance (αH	$\pm$ 12.8	
(mrad) (αV	$\pm$ 4	
Solid angle $\Omega = \pi \alpha H \times \alpha V$ (μsterad)	160	
Horizontal magnification at momentum slit	2.3	
Dispersion at momentum slit (mm/% $\Delta p/p$)	9.3	
Theoretical momentum resolution[2] (%)	$\pm$ 0.7	
Optical characteristics at reference focus[1]	South	North[3]
dispersion (mm/% $\Delta p/p$) (H	---	28
(V		
magnification (H	3.2	3.5
(V	3.4	3.6
Calculated beam cross-section for full beam angular acceptance and $\Delta p/p = \pm 1$ % (mm)	30Hx25V	70Hx30V

---

[1] 10 m downstream of the last vertical dipole

[2] For a 3x3 mm^2 apparent production target

[3] In the North branch, the chromatic dispersion is not compensated

Current values (A) take non-linear effects into account.

16-june-1993.
L. Durieu

Magnet	T7BHZ01	T7QFO01	T7QDE02	T7BHZ02	T7QFO03	T7QDE04	T7QFO05	T7BHZ03	T7DVTS1	T7DVTN2
Supply	R2a 23	R2b 06	R2g 01	R2b 05	R2 10	R2g 02	R2a 21	R2 18	R2a 26	R2a 22
Momentum										
GeV/c										
1.0	57.0	63.8	50.7	77.7	36.4	38.2	36.0	57.0	trim	stand-by
1.5	85.5	95.7	76.1	116.5	54.6	57.3	54.1	85.5	trim	stand-by
2.0	113.9	127.6	101.4	155.3	72.9	76.4	72.1	113.9	trim	stand-by
2.5	142.4	159.6	126.8	194.1	91.1	95.6	90.1	142.4	trim	stand-by
3.0	170.9	191.5	152.2	232.9	109.4	114.7	108.2	170.9	trim	stand-by
3.5	199.4	223.4	177.5	271.6	127.6	133.9	126.3	199.4	trim	stand-by
4.0	228.1	255.4	202.9	310.3	146.0	153.1	144.4	228.1	trim	stand-by
4.5	256.9	287.3	228.3	349.0	164.3	172.4	162.6	256.9	trim	stand-by
5.0	286.1	319.3	253.7	387.7	182.8	191.8	180.8	286.1	trim	stand-by
5.5	315.7	351.3	279.1	426.3	201.3	211.3	199.1	315.7	trim	stand-by
6.0	345.8	383.3	304.5	465.1	219.9	230.9	217.5	345.8	trim	stand-by
6.5	376.8	415.3	329.9	503.9	238.7	250.7	236.1	376.8	trim	stand-by
7.0	408.8	447.4	355.3	543.1	257.6	270.7	254.8	408.8	trim	stand-by
7.5	442.3	479.4	380.8	582.6	276.8	291.0	273.7	442.3	trim	stand-by
8.0	477.9	511.5	406.2	622.7	296.3	311.7	292.9	477.9	trim	stand-by
8.5	516.3	543.6	431.7	663.9	316.0	332.8	312.4	516.3	trim	stand-by
9.0	558.8	575.8	457.2	706.7	336.2	354.4	332.3	558.8	trim	stand-by
9.5	607.9	608.0	482.6	752.0	357.0	376.7	352.7	607.9	trim	stand-by
10.0	668.0	640.2	508.2	802.1	378.3	400.0	373.7	668.0	trim	stand-by

Table 5.
Magnet settings for beam T7S, nominal focus.

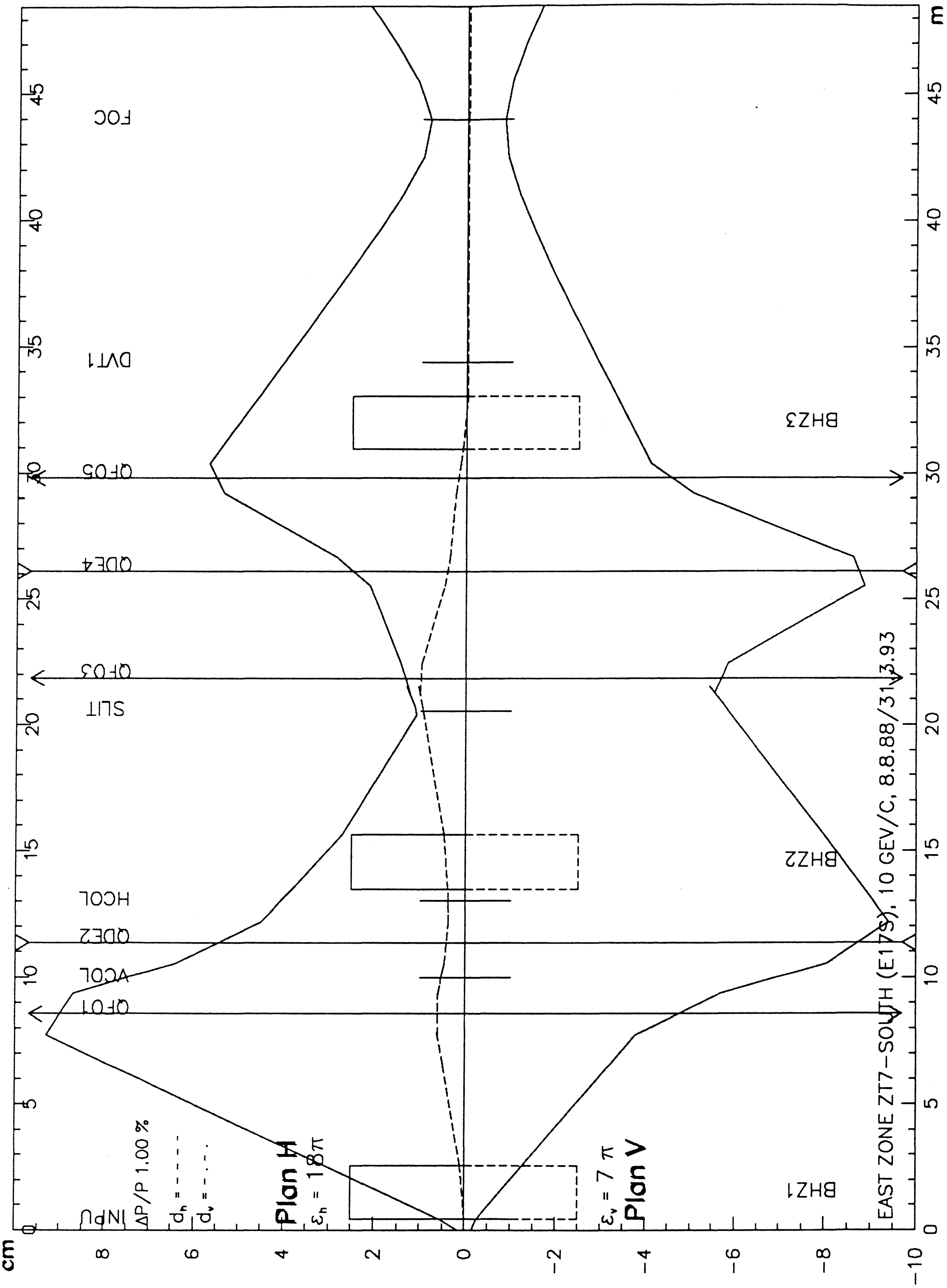


Fig. 7 - Nominal optics for beam T7 south

Current values (A) take
non-linear effects into account.

16-june-1993.
L. Durieu.

Magnet	T7QDE04	T7QFO05	T7QDE04	T7QFO05	T7QDE04	T7QFO05	T7QDE04	T7QFO05
Momentum								
GeV/c	0 m		+5 m		+10 m		+15 m	
1.0	38.2	36.0	36.7	32.8	35.7	30.9	35.0	29.7
1.5	57.3	54.1	55.1	49.3	53.6	46.4	52.5	44.5
2.0	76.4	72.1	73.4	65.7	71.4	61.9	70.0	59.4
2.5	95.6	90.1	91.8	82.1	89.3	77.4	87.5	74.2
3.0	114.7	108.2	110.2	98.6	107.2	92.9	105.0	89.1
3.5	133.9	126.3	128.6	115.1	125.1	108.4	122.6	104.0
4.0	153.1	144.4	147.1	131.6	143.0	123.9	140.2	118.8
4.5	172.4	162.6	165.6	148.1	161.0	139.5	157.8	133.7
5.0	191.8	180.8	184.1	164.6	179.1	155.1	175.5	148.7
5.5	211.3	199.1	202.8	181.3	197.2	170.7	193.2	163.6
6.0	230.9	217.5	221.6	198.0	215.5	186.4	211.1	178.7
6.5	250.7	236.1	240.5	214.7	233.8	202.1	229.0	193.7
7.0	270.7	254.8	259.6	231.6	252.3	217.9	247.2	208.9
7.5	291.0	273.7	279.0	248.6	271.1	233.9	265.4	224.1
8.0	311.7	292.9	298.6	265.8	290.0	249.9	284.0	239.4
8.5	332.8	312.4	318.6	283.2	309.3	266.1	302.7	254.8
9.0	354.4	332.3	339.0	300.8	329.0	282.5	321.9	270.4
9.5	376.7	352.7	360.0	318.7	349.1	299.0	341.4	286.1
10.0	400.0	373.7	381.6	336.9	369.7	315.9	361.4	302.1

Table 6.
Focus adjustment in
the beam T7S

Beam t7-S

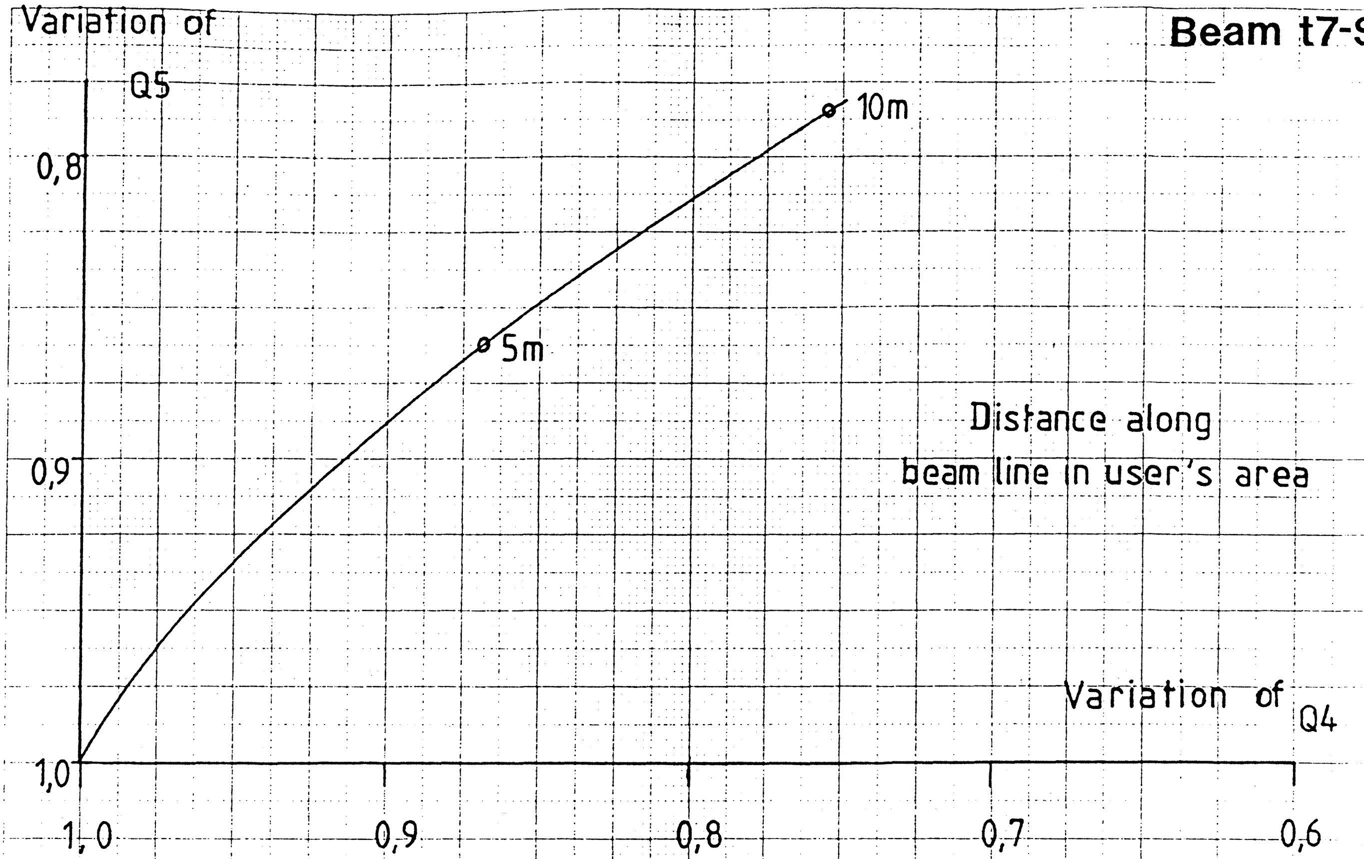


Fig. 8 . DISPLACEMENT OF BEAM WAIST IN USER'S AREA; FACTORS FOR VARIATION OF Q4 AND Q5.

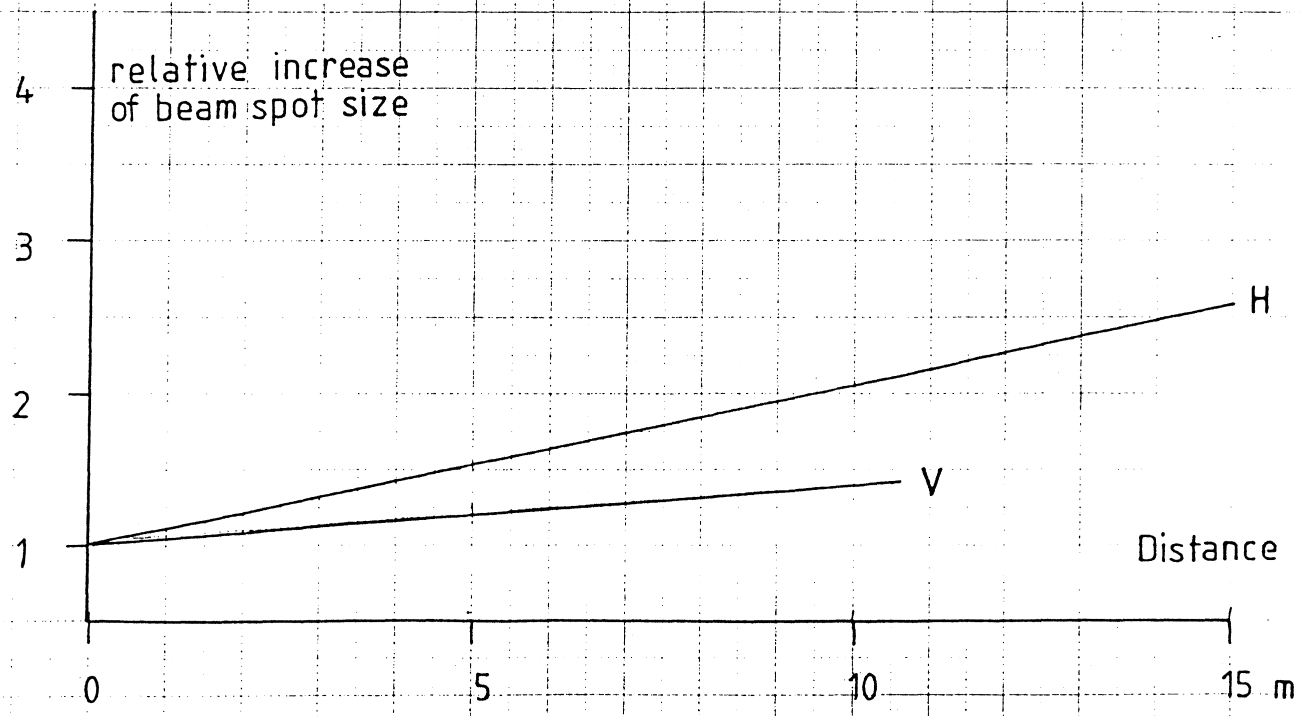


Fig. 9 . RELATIVE INCREASE OF BEAM SPOT SIZE IN USER'S AREA. (without scattering).

Current values (A) take non-linear effects into account.

16-june-1993.
L. Durieu.

Magnet	T7BHZ01	T7QFO01	T7QDE02	T7BHZ02	T7QFO03	T7QDE04	T7QFO05	T7BHZ03	T7DVTS1	T7DVTN2
Supply	R2a 23	R2b 06	R2g 01	R2b 05	R2 10	R2g 02	R2a 21	R2 18	R2a 26	R2a 22
Momentum										
GeV/c										
1.0	57.0	64.1	52.0	77.7	36.4	38.2	38.7	57.0	stand-by	trim
1.5	85.5	96.2	78.0	116.5	54.6	57.3	58.0	85.5	stand-by	trim
2.0	113.9	128.3	104.0	155.3	72.9	76.4	77.4	113.9	stand-by	trim
2.5	142.4	160.3	130.0	194.1	91.1	95.6	96.7	142.4	stand-by	trim
3.0	170.9	192.4	156.1	232.9	109.4	114.7	116.1	170.9	stand-by	trim
3.5	199.4	224.5	182.1	271.6	127.6	133.9	135.5	199.4	stand-by	trim
4.0	228.1	256.6	208.1	310.3	146.0	153.1	155.0	228.1	stand-by	trim
4.5	256.9	288.7	234.1	349.0	164.3	172.4	174.6	256.9	stand-by	trim
5.0	286.1	320.9	260.2	387.7	182.8	191.8	194.2	286.1	stand-by	trim
5.5	315.7	353.0	286.2	426.3	201.3	211.3	213.9	315.7	stand-by	trim
6.0	345.8	385.2	312.3	465.1	219.9	230.9	233.8	345.8	stand-by	trim
6.5	376.8	417.4	338.4	503.9	238.7	250.7	253.9	376.8	stand-by	trim
7.0	408.8	449.6	364.4	543.1	257.6	270.7	274.2	408.8	stand-by	trim
7.5	442.3	481.8	390.5	582.6	276.8	291.0	294.8	442.3	stand-by	trim
8.0	477.9	514.1	416.6	622.7	296.3	311.7	315.8	477.9	stand-by	trim
8.5	516.3	546.3	442.8	663.9	316.0	332.8	337.2	516.3	stand-by	trim
9.0	558.8	578.6	468.9	706.7	336.2	354.4	359.3	558.8	stand-by	trim
9.5	607.9	611.0	495.0	752.0	357.0	376.7	382.1	607.9	stand-by	trim
10.0	668.0	643.3	521.2	802.1	378.3	400.0	405.8	668.0	stand-by	trim

Table 7.
Magnet settings for beam T7N, nominal focus.

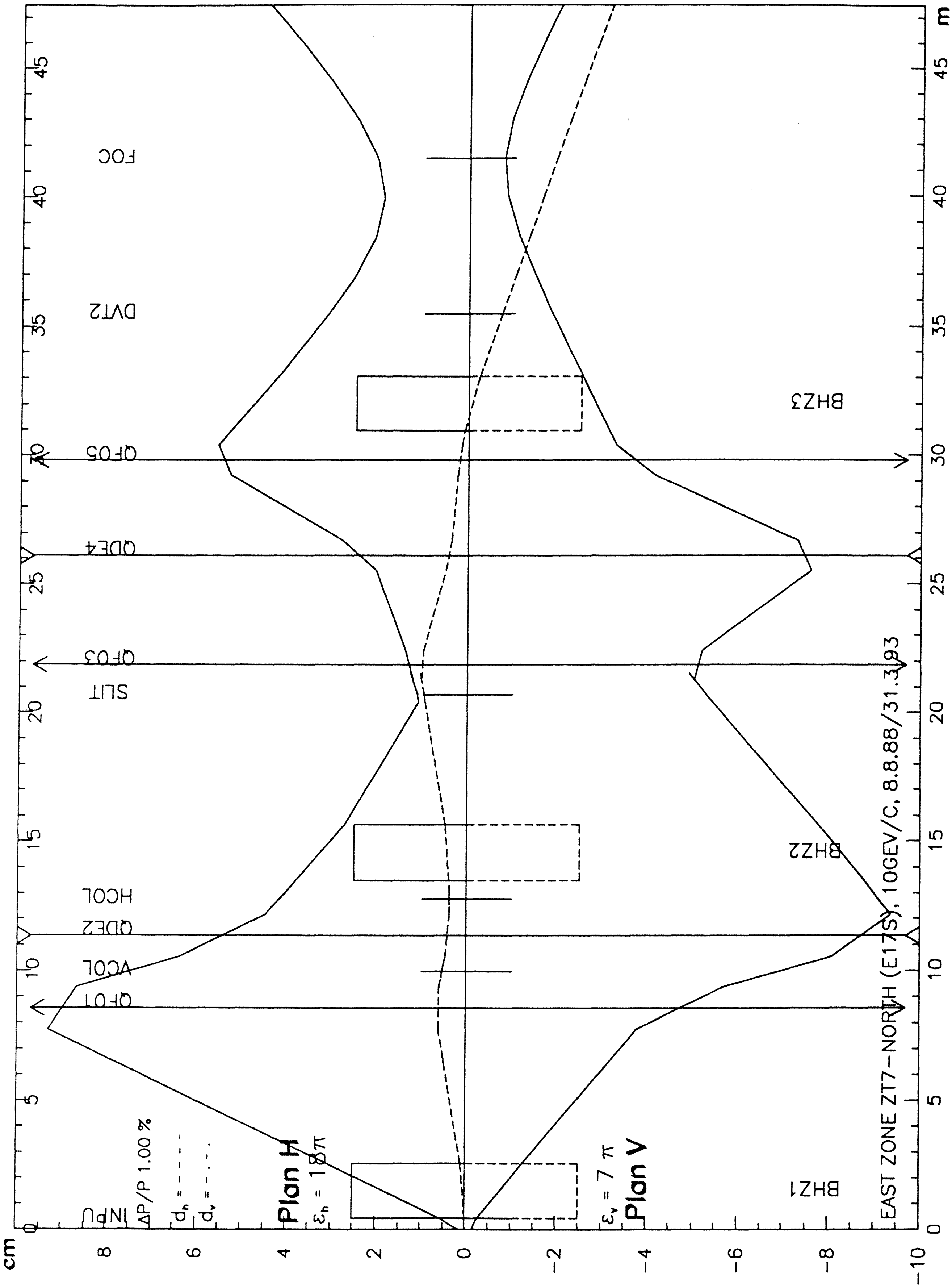


Fig. 10 - Nominal optics for beam T7 north

Current values (A) take non-linear effects into account.

16-june-1993.
L. Durieu.

Magnet	T7QDE04	T7QFO05	T7QDE04	T7QFO05	T7QDE04	T7QFO05	T7QDE04	T7QFO05
Momentum								
GeV/c	0 m		+5 m		+10 m		+15 m	
1.0	38.2	38.7	36.3	34.2	35.1	31.8	34.2	30.3
1.5	57.3	58.0	54.4	51.3	52.6	47.7	51.3	45.4
2.0	76.4	77.4	72.6	68.5	70.1	63.6	68.5	60.5
2.5	95.6	96.7	90.7	85.6	87.7	79.5	85.6	75.7
3.0	114.7	116.1	108.9	102.7	105.3	95.4	102.7	90.8
3.5	133.9	135.5	127.1	119.9	122.9	111.4	119.9	106.0
4.0	153.1	155.0	145.4	137.1	140.5	127.3	137.1	121.1
4.5	172.4	174.6	163.7	154.3	158.1	143.3	154.3	136.3
5.0	191.8	194.2	182.0	171.6	175.9	159.3	171.6	151.6
5.5	211.3	213.9	200.4	189.0	193.7	175.4	189.0	166.8
6.0	230.9	233.8	219.0	206.4	211.5	191.5	206.4	182.2
6.5	250.7	253.9	237.7	223.9	229.5	207.7	223.9	197.5
7.0	270.7	274.2	256.5	241.6	247.7	224.0	241.6	213.0
7.5	291.0	294.8	275.6	259.4	266.0	240.4	259.4	228.5
8.0	311.7	315.8	295.0	277.4	284.6	257.0	277.5	244.2
8.5	332.8	337.2	314.6	295.7	303.4	273.7	295.7	259.9
9.0	354.4	359.3	334.7	314.3	322.6	290.6	314.3	275.9
9.5	376.7	382.1	355.3	333.2	342.2	307.8	333.2	292.0
10.0	400.0	405.8	376.5	352.6	362.3	325.2	352.6	308.3

Table 8.
Focus adjustment in the beam T7N.

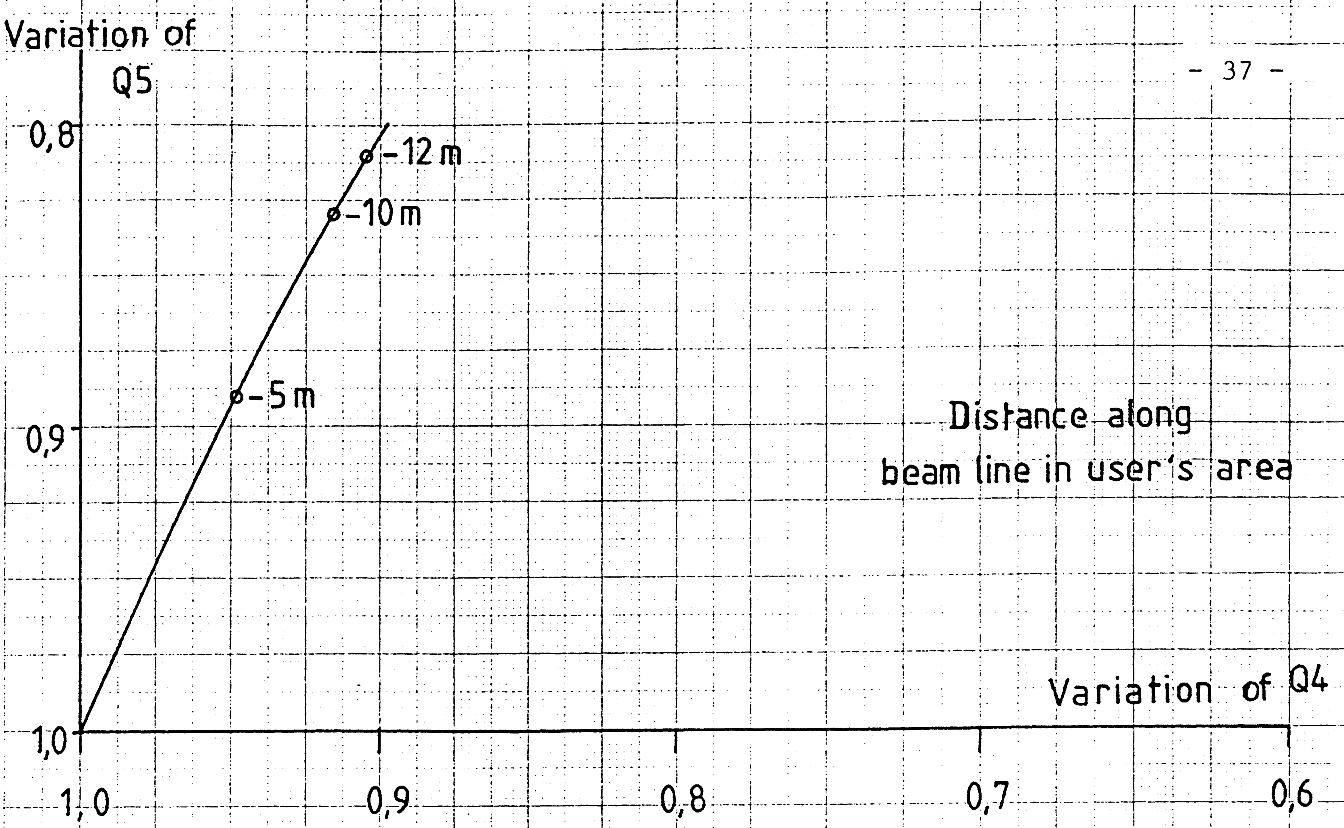


Fig.11 _DISPLACEMENT OF BEAM WAIST IN USER'S AREA; FACTORS FOR VARIATION OF Q4 AND Q5.

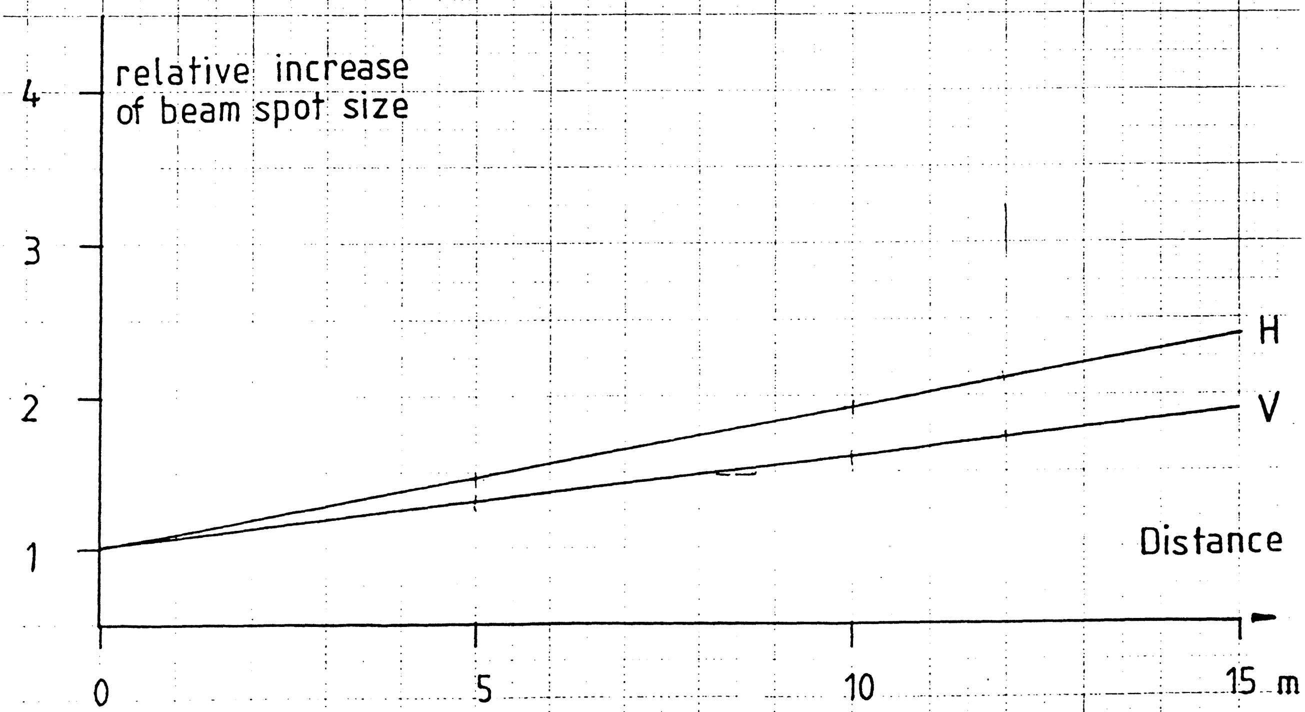


Fig 12 _RELATIVE INCREASE OF BEAM SPOT SIZE IN USER'S AREA. (without scattering).

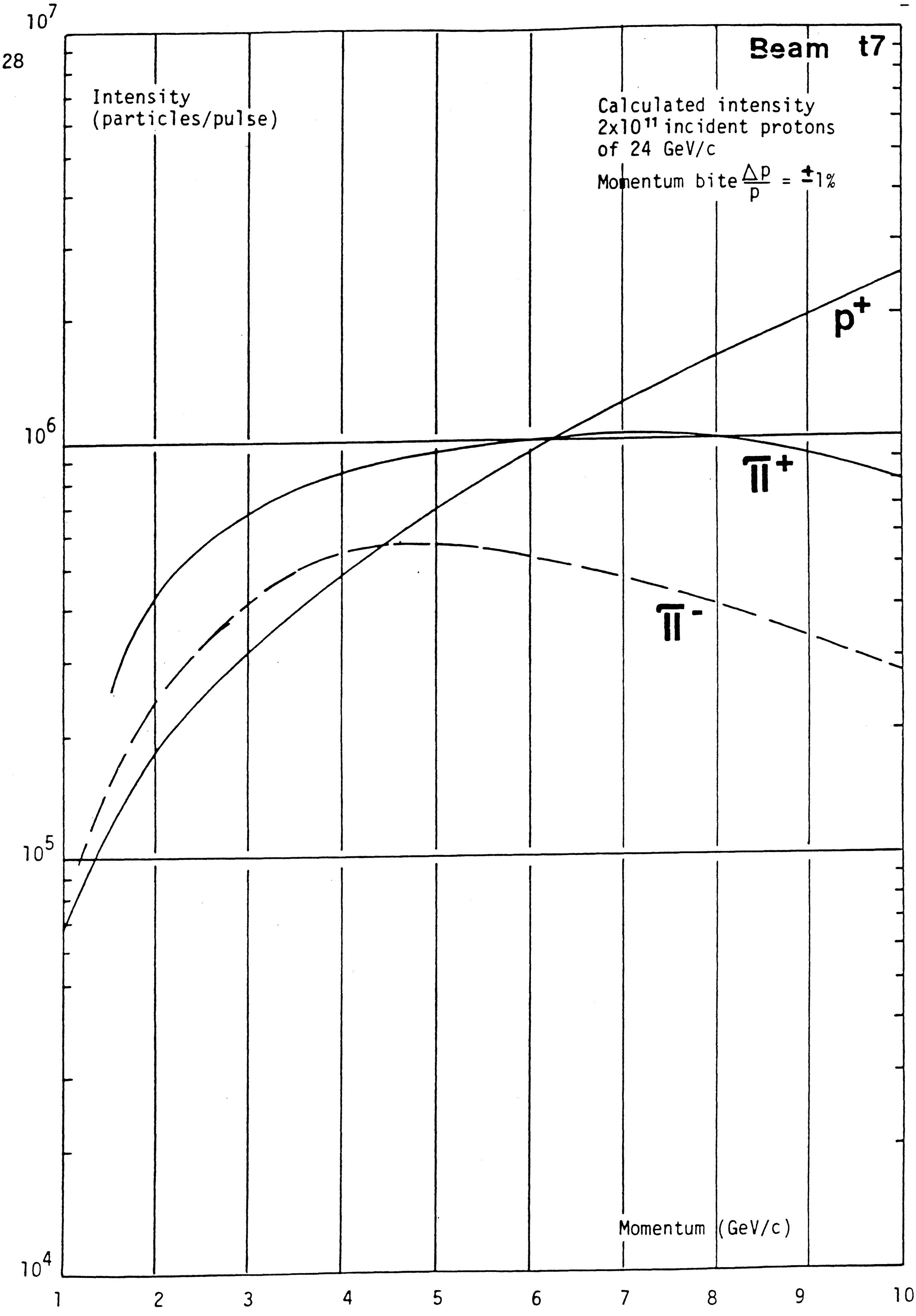


Fig. 13 Calculated intensity at the reference focus of t7.

Beam t7

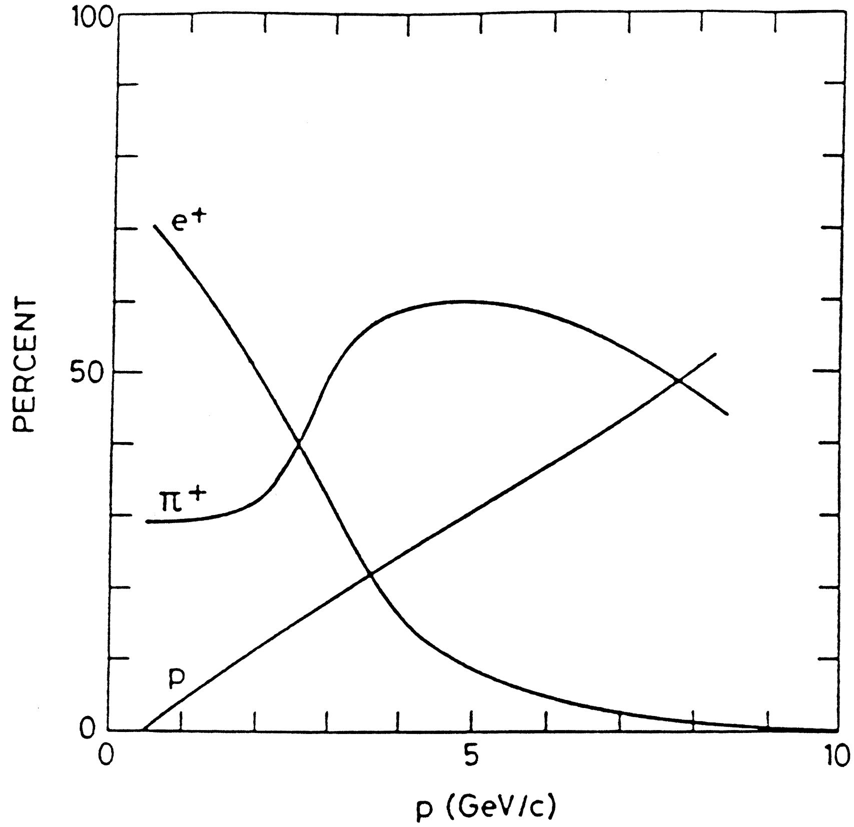


Fig. 14 Relative distribution of protons, pions and positrons in the t7-beam, as measured by PS188 (Ref. 6,7)

TABLE 9

CHARACTERISTICS OF THE BEAM t9

Maximum design momentum (GeV/c)		10
Length at reference focus[1] (m)		34.5
Beam height (m)		2.28
Production angle (mrad)	(H	---
	(V	---
	(total	0
Angular acceptance (mrad)	(αH	± 3.6
	(αV	± 5.1
Solid angle $\Omega = \pi\alpha H \times \alpha V$ (μsterad)		58
Horizontal magnification at momentum slit		1.15
Dispersion at momentum slit (mm/% Δp/p)		4.2
Theoretical momentum resolution[2] (%)		± 1.1
Optical characteristics at reference focus[1]		
dispersion (mm/% Δp/p)	(H	---
	(V	0.7
magnification	(H	1.4
	(V	0.3
Calculated beam cross-section for full beam angular acceptance and Δp/p = ± 1 % (mm)		9Hx4V

[1] 2.5 m downstream of the last vertical dipole

[2] For a 4x4 mm^2 apparent production target

Current values (A) take non-linear effects into account.

21-apr-1993.
L. Durieu.

Magnet	T9QDE01	T9QFO02	T9BHZ01	T9QFO03	T9BHZ02	T9QFO04	T9QDE05	T9BVT02
Supply	R2a 27	R2a 28	R31 01	R2g 04	R3 06	R2g 05	R2a 26	R2g 03
Momentum								
GeV/c								
1.0	37.1	32.8	89.3	19.8	46.6	40.5	45.2	26.8
2.0	74.3	65.7	178.6	39.6	93.2	81.0	90.4	53.6
3.0	111.7	98.4	267.9	59.4	139.8	121.5	135.7	80.3
4.0	149.3	131.2	357.3	79.2	186.4	162.2	181.2	106.8
5.0	187.3	163.9	446.6	99.1	232.9	203.0	226.9	133.3
6.0	225.5	196.7	536.0	119.1	279.4	244.1	273.0	159.6
7.0	264.1	229.5	625.4	139.1	325.8	285.5	319.6	185.9
8.0	302.9	262.6	714.8	159.3	372.2	327.4	367.0	212.4
9.0	341.9	296.0	804.3	179.5	418.6	370.0	415.6	239.1
10.0	380.9	330.1	893.9	199.8	465.1	413.5	465.8	266.2
11.0	419.8	365.2	983.5	220.2	511.7	458.3	518.5	294.1
12.0	458.4	401.8	1073.2	240.7	558.8	505.0	575.1	323.1
13.0	496.8	440.9	1162.9	261.2	606.6	554.4	638.5	353.8
14.0	534.8	483.8	1252.7	281.9	655.6	608.2	716.6	387.1
15.0	572.8	533.3	1342.6	302.6	706.7	669.9	****	424.4

Table 10.
Magnet settings for beam T9, nominal focus.

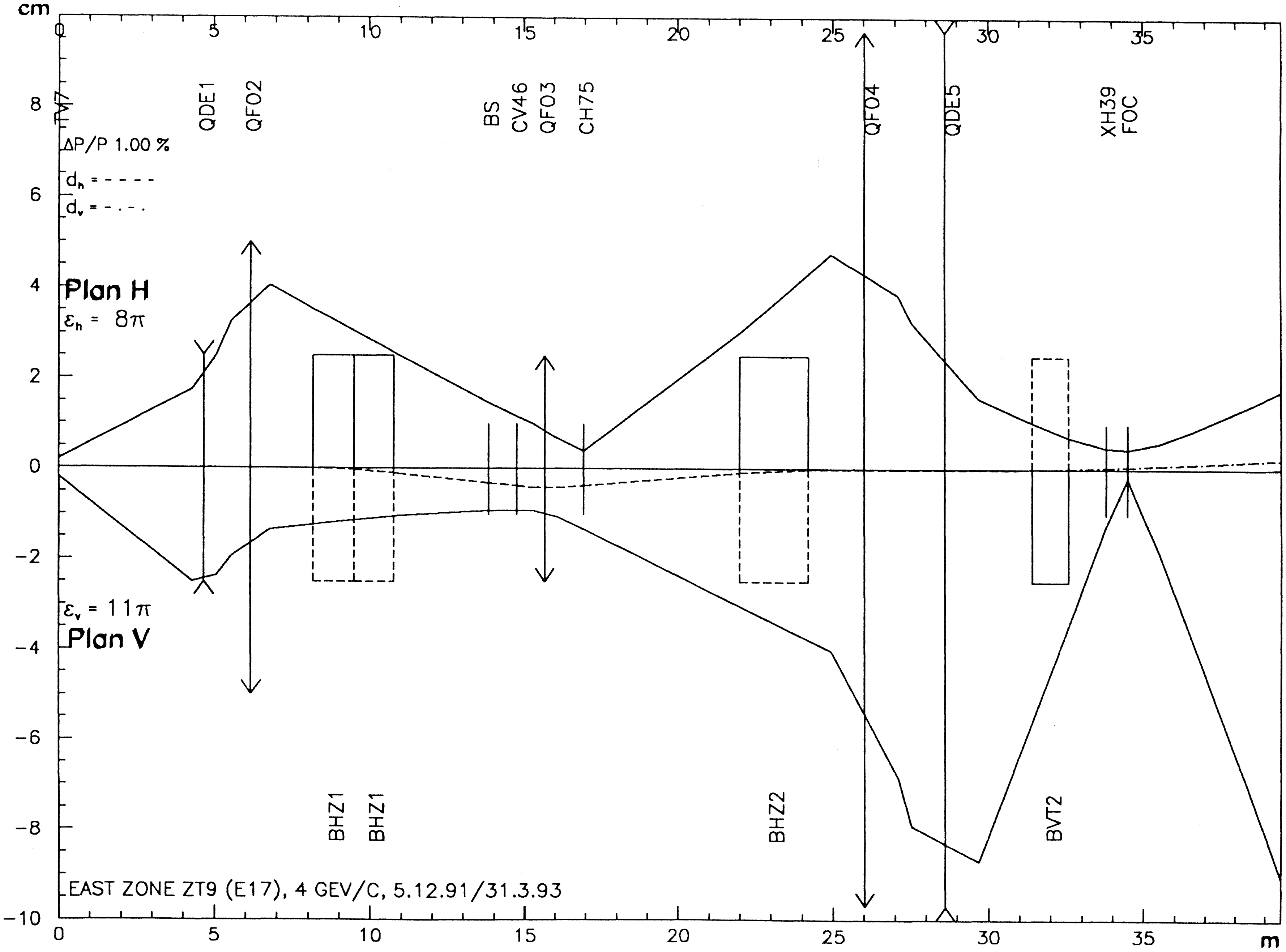


Fig. 15 - Nominal optics for beam T9

Current values (A) take non-linear effects into account.

21-apr-1993.
L. Durieu.

Magnet	T9QFO04	T9QDE05	T9QFO04	T9QDE05	T9QFO04	T9QDE05	T9QFO04	T9QDE05	T9QFO04	T9QDE05
Momentum GeV/c	**0 m**		**+5 m**		**+10 m**		**+15 m**		**+20 m**	
1.0	40.5	45.2	35.7	33.8	33.4	29.5	32.0	27.3	31.1	25.9
2.0	81.0	90.4	71.4	67.5	66.8	59.0	64.1	54.6	62.2	51.8
3.0	121.5	135.7	107.2	101.3	100.3	88.6	96.1	81.9	93.4	77.7
4.0	162.2	181.2	143.1	135.2	133.8	118.2	128.2	109.2	124.5	103.6
5.0	203.0	226.9	179.0	169.2	167.4	147.8	160.4	136.5	155.8	129.6
6.0	244.1	273.0	215.1	203.3	201.1	177.5	192.7	164.0	187.1	155.6
7.0	285.5	319.6	251.4	237.5	235.0	207.3	225.2	191.5	218.6	181.6
8.0	327.4	367.0	288.0	272.0	269.1	237.3	257.8	219.1	250.2	207.8
9.0	370.0	415.6	325.0	306.7	303.4	267.4	290.6	246.8	282.1	234.1
10.0	413.5	465.8	362.5	341.9	338.2	297.8	323.8	274.7	314.2	260.4
11.0	458.3	518.5	400.6	377.6	373.4	328.4	357.4	302.8	346.7	287.0
12.0	505.0	575.1	439.7	414.0	409.3	359.4	391.5	331.1	379.6	313.7
13.0	554.4	638.5	480.0	451.3	446.1	390.8	426.2	359.8	413.1	340.7
14.0	608.2	716.6	522.1	489.8	484.0	422.8	461.9	388.8	447.4	368.0
15.0	669.9	****	566.7	530.0	523.5	455.6	498.8	418.3	482.7	395.7

**Table 11.
Focus adjustment in
the beam T9.**

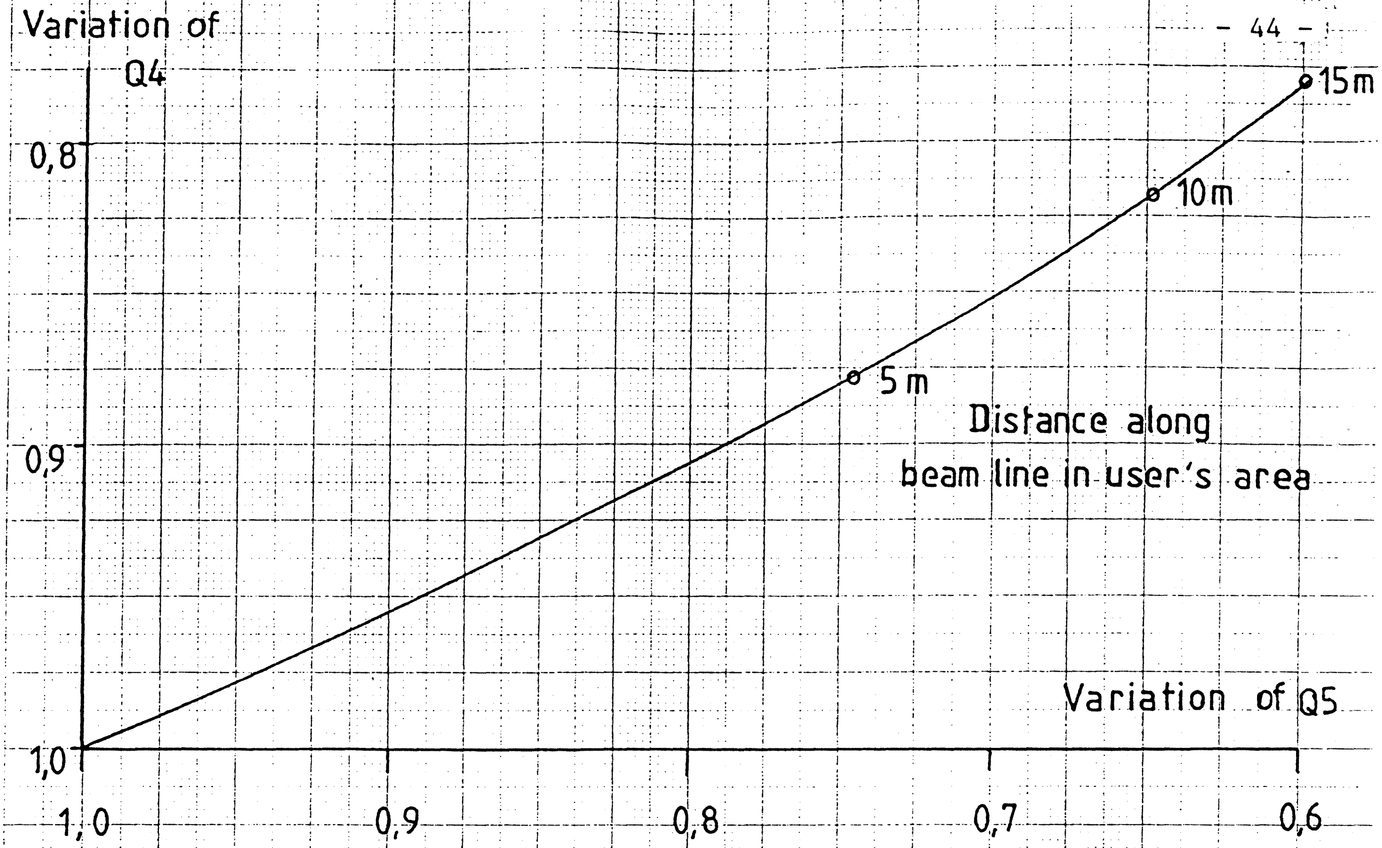


Fig.16 _DISPLACEMENT OF BEAM WAIST IN USER'S AREA;
FACTORS FOR VARIATION OF Q4 AND Q5.

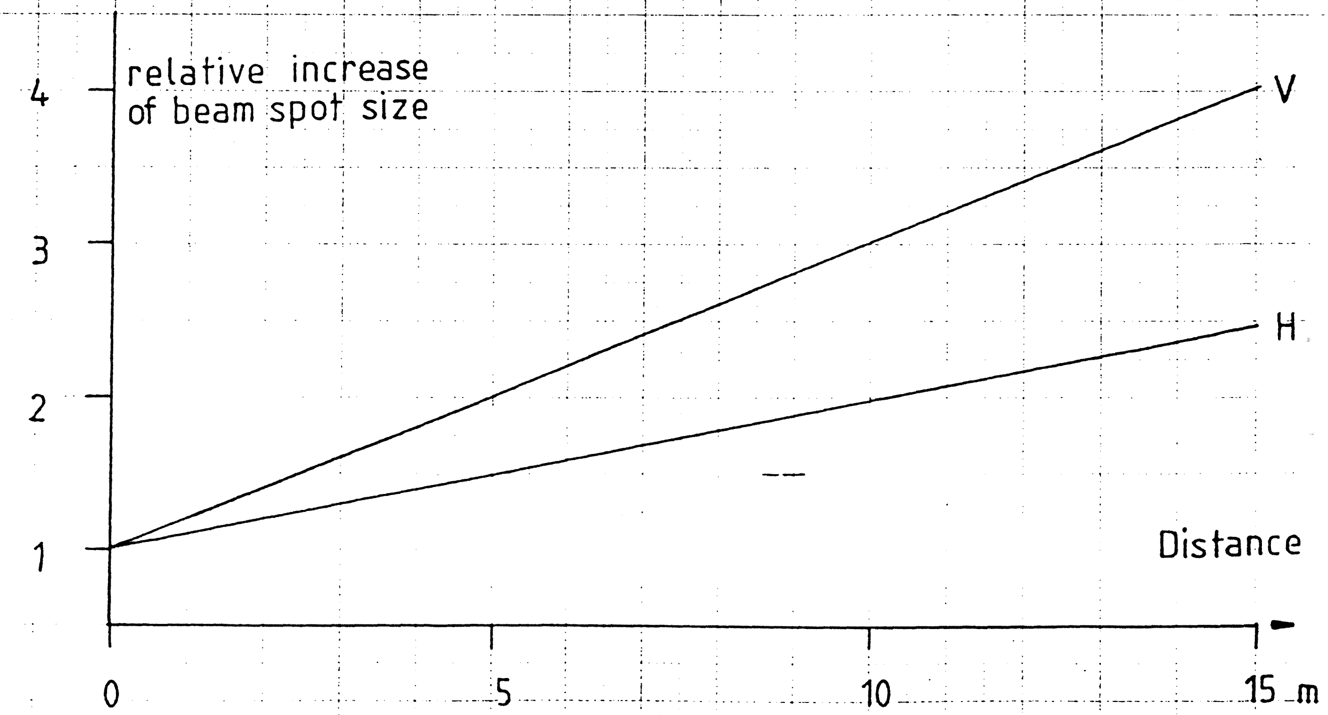


Fig. 17 _RELATIVE INCREASE OF BEAM SPOT SIZE IN USER'S AREA.
(without scattering).

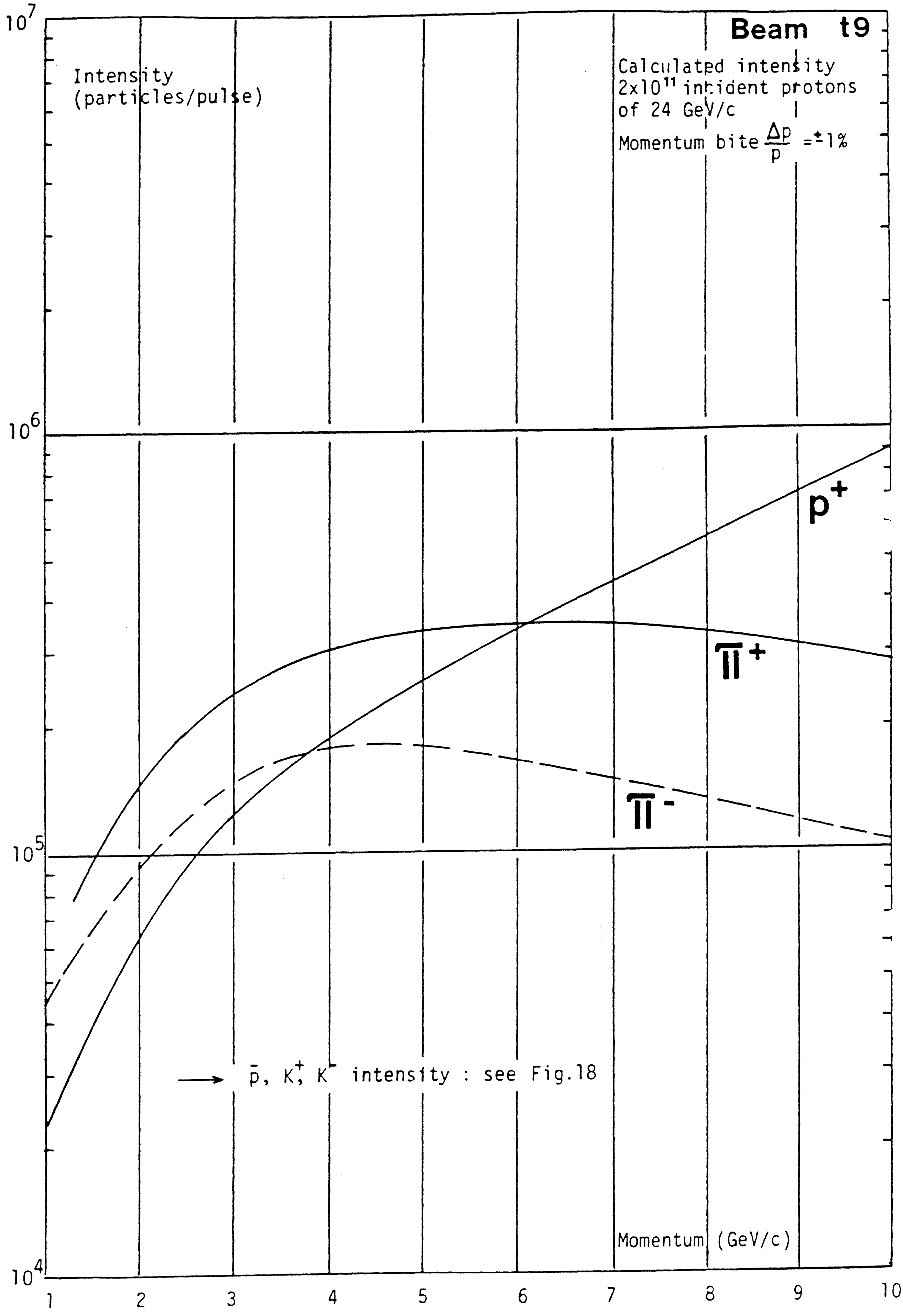


Fig. 18 : Calculated intensity at the reference focus of t9.

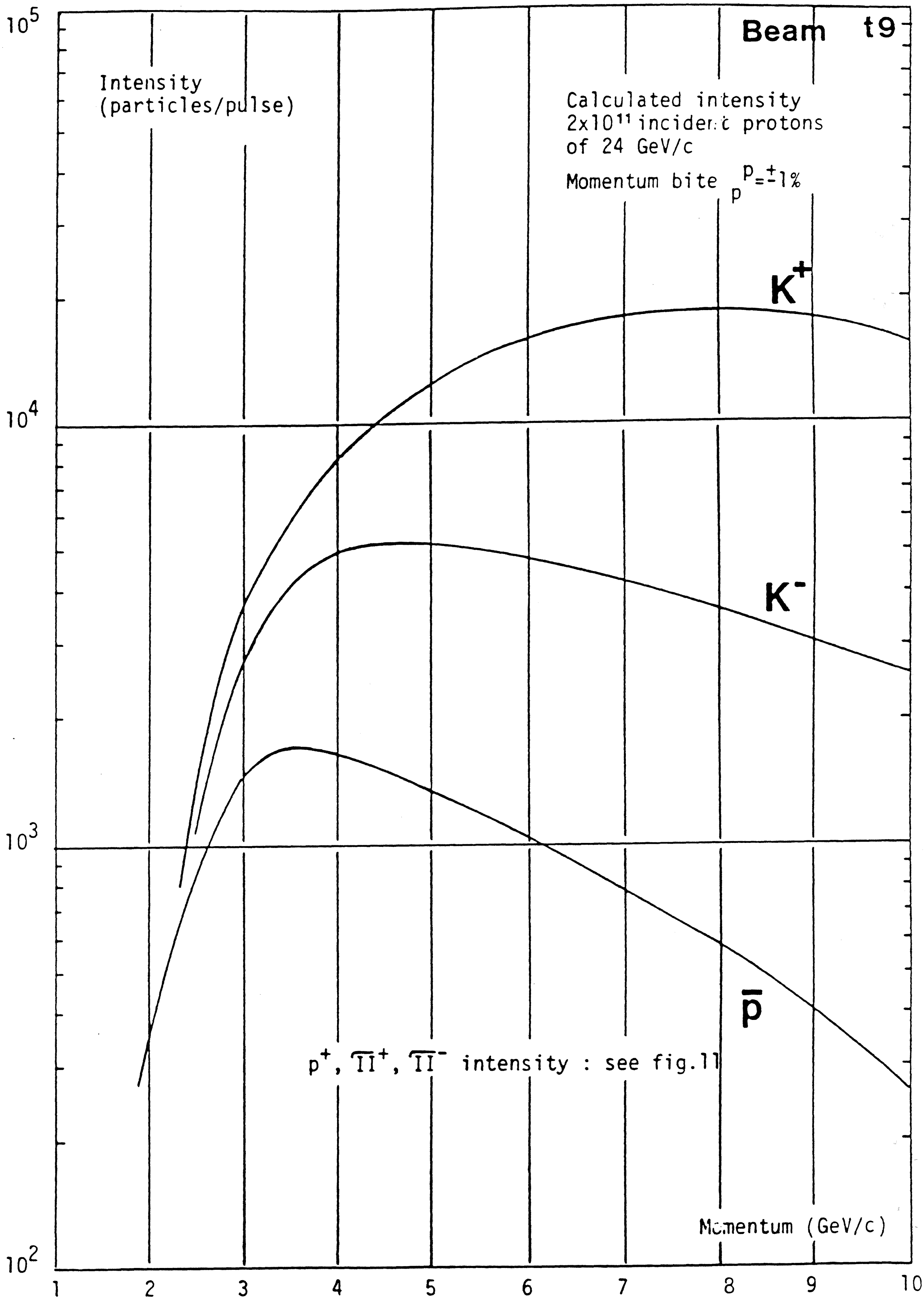


Fig. 19 : Calculated intensity at the reference focus of t9

TABLE 12

CHARACTERISTICS OF THE BEAM t10

Maximum design momentum (GeV/c)	5
Length at reference focus[1] (m)	33
Beam height (m)	2.50
Production angle (H (mrad) (V (total	61.06 8.24 61.6
Angular acceptance (αH (mrad) (αV	± 5 ± 12.7
Solid angle $\Omega = \pi\alpha H \times \alpha V$ (μsterad)	200
Horizontal magnification at momentum slit	3.
Dispersion at momentum slit (mm/% Δp/p)	9.
Theoretical momentum resolution[2] (%)	± 1.3
Optical characteristics at reference focus[1]	
dispersion (mm/% Δp/p) (H (V	0 1
magnification (H (V	0.7 0.85
Calculated beam cross-section for full beam angular acceptance and Δp/p = ± 1 % (mm)	16Hx7.4V

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[1] 2.5 m downstream of the last vertical dipole

[2] For a 4x4 mm^2 apparent production target

Current values (A) take non-linear effects into account.

21-apr-1993.
L. Durieu.

Magnet	T10QDE1	T10QFO2	T10BHZ1	T10QFO3	T10BHZ2	T10QFO4	T10QDE5	T10BVT2
Supply	R2 01	R2 11	R3 04	R1 17	R3 03	R2 13	R2 05	R2 16
Momentum								
GeV/c								
1.0	83.9	92.5	155.3	42.5	155.3	62.7	69.8	32.9
1.5	126.3	139.5	232.9	63.6	232.9	94.0	104.8	49.3
2.0	169.3	187.1	310.3	84.8	310.3	125.4	139.9	65.8
2.5	213.0	235.8	387.7	105.9	387.7	157.0	175.1	82.4
3.0	257.6	285.7	465.1	126.9	465.1	188.7	210.6	99.0
3.5	303.3	336.9	543.1	148.0	543.1	220.7	246.6	115.8
4.0	350.2	389.6	622.7	169.0	622.7	253.1	283.3	132.6
4.5	398.3	443.9	706.7	190.0	706.7	286.1	321.1	149.5
5.0	447.6	499.9	802.1	211.0	802.1	320.0	360.5	166.6

**Table 13.
Magnet settings for beam T10,
nominal focus.**

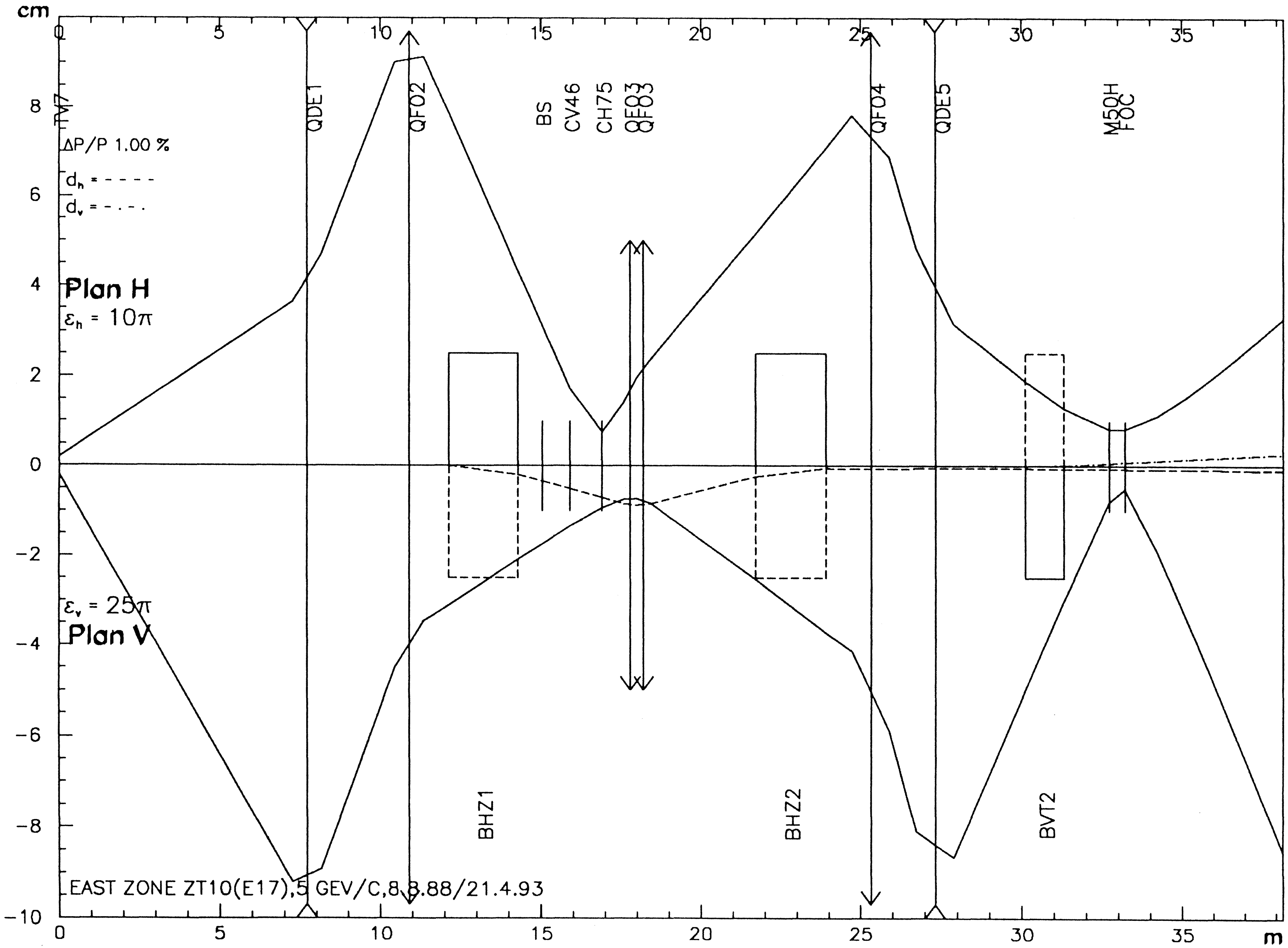

Fig. 20 - Nominal optics for beam T10

Current values (A) take non-linear effects into account.

21-apr-1993.
L. Durieu.

Magnet	T10QFO4	T10QDE5	T10QFO4	T10QDE5	T10QFO4	T10QDE5	T10QFO4	T10QDE5
Momentum								
GeV/c	**0 m**		**5 m**		**10 m**		**15 m**	
1.0	62.7	69.8	55.4	54.4	51.9	48.5	49.8	45.3
1.5	94.0	104.8	83.0	81.6	77.8	72.7	74.8	68.0
2.0	125.4	139.9	110.8	108.8	103.8	97.0	99.7	90.7
2.5	157.0	175.1	138.6	136.1	129.9	121.3	124.7	113.4
3.0	188.7	210.6	166.5	163.5	156.0	145.6	149.8	136.1
3.5	220.7	246.6	194.5	191.0	182.2	170.1	174.9	158.9
4.0	253.1	283.3	222.8	218.8	208.6	194.6	200.2	181.8
4.5	286.1	321.1	251.5	246.8	235.3	219.4	225.8	204.9
5.0	320.0	360.5	280.6	275.3	262.3	244.4	251.5	228.1

**Table 14.
Focus adjustment in
the beam T10.**

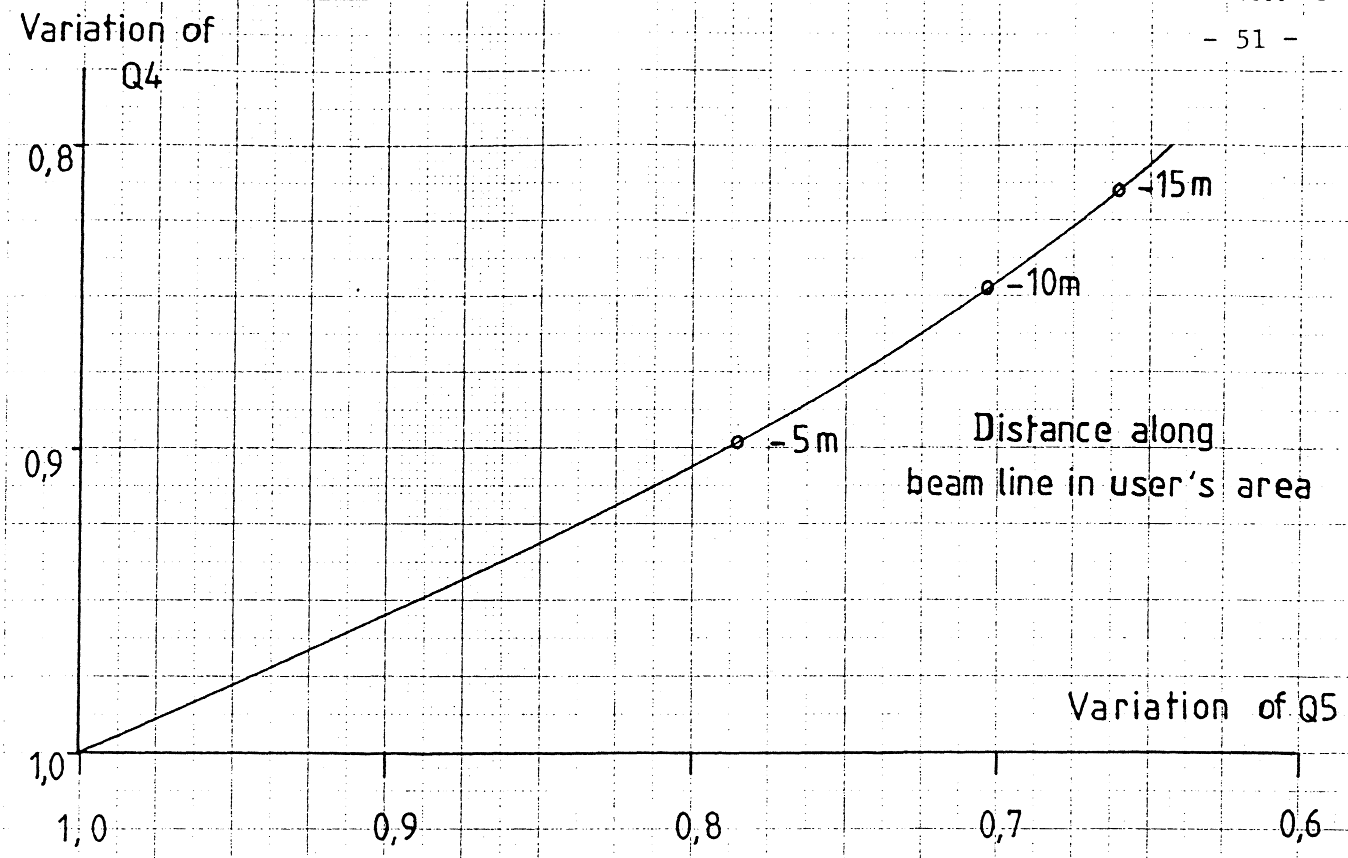

Fig. 21 – DISPLACEMENT OF BEAM WAIST IN USER'S AREA; FACTORS FOR VARIATION OF Q4 AND Q5.

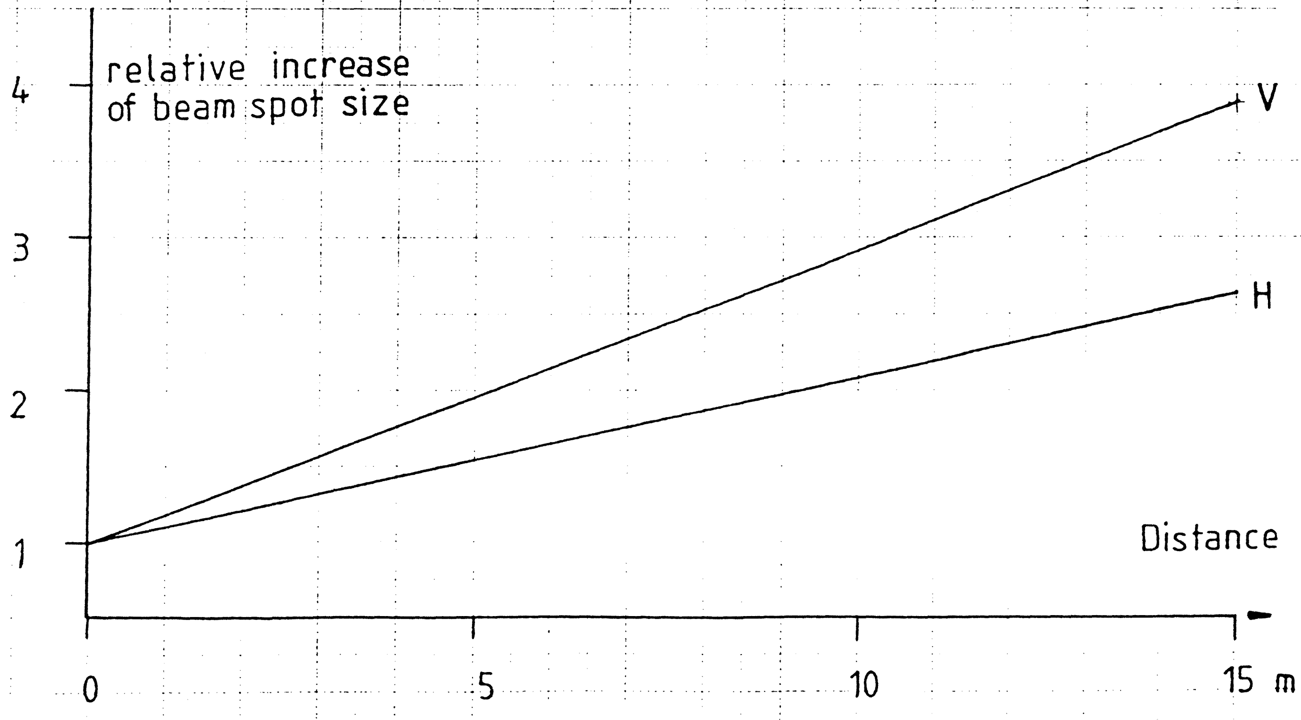

Fig. 22 – RELATIVE INCREASE OF BEAM SPOT SIZE IN USER'S AREA. (without scattering).

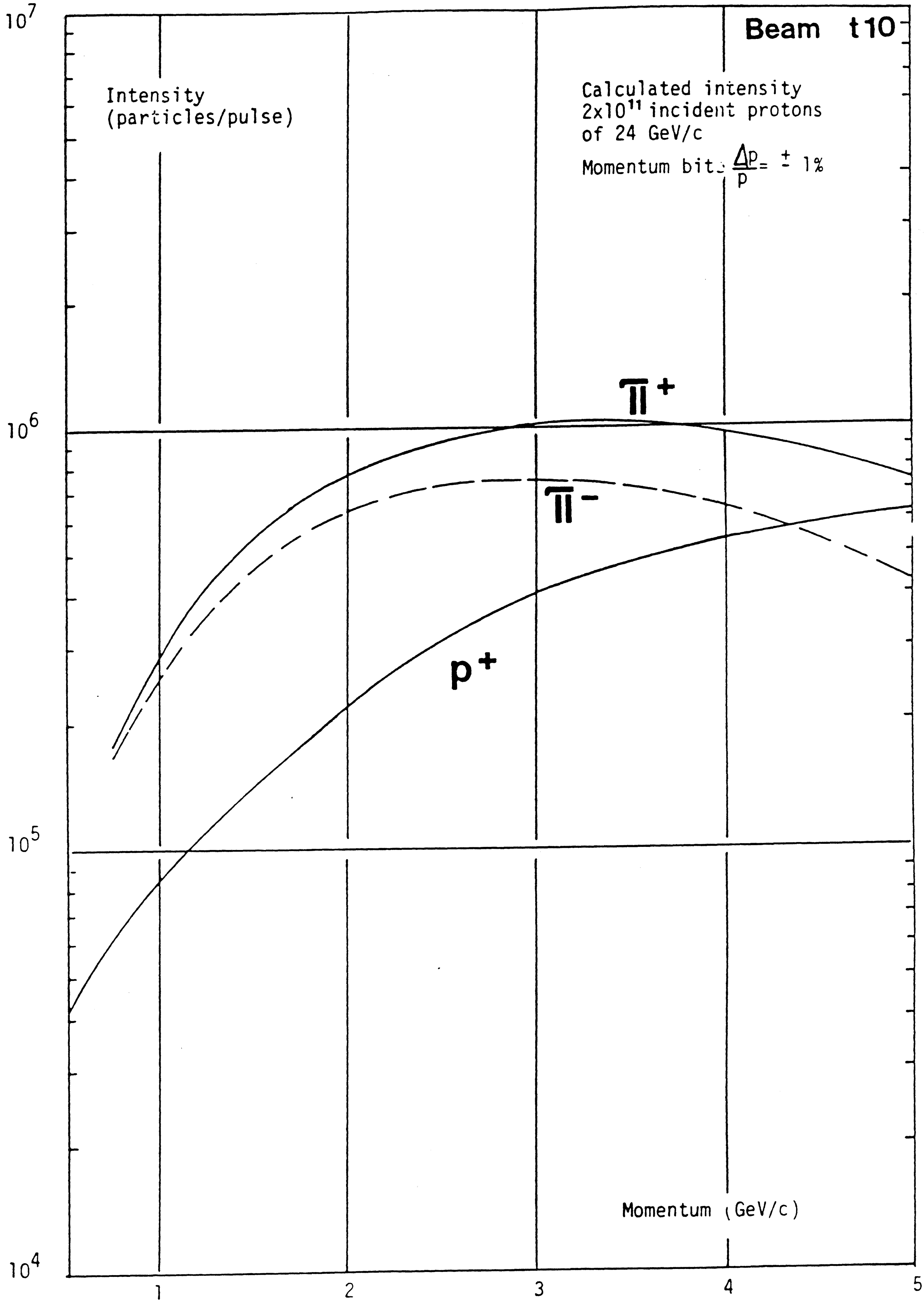

Fig. 23 : Calculated intensity at the reference focus of t10.

T A B L E 15

CHARACTERISTICS OF THE BEAM t11

Maximum design momentum (GeV/c)		3.5
Length at reference focus[1] (m)		28.
Beam height (m)		2.5
Production angle (mrad)	(H	148.36
	(V	16.06
	(total	149.2
Angular acceptance (mrad)	(αH	± 6.2
	(αV	± 19.7
Solid angle Ω = παH χ αV (μsterad)		384
Horizontal magnification at momentum slit		3.6
Dispersion at momentum slit (mm/% Δp/p)		7.5
Theoretical momentum resolution[2] (%)		± 1.9
Optical characteristics at reference focus[1]		
dispersion (mm/% Δp/p)	(H	0
	(V	1.1
magnification	(H	0.7
	(V	1.3
Calculated beam cross-section for full beam angular acceptance and Δp/p = ± 1 % (mm)		18Hx10V

[1] 2.5 m downstream of the last vertical dipole

[2] For a 4x4 mm^2 apparent production target

Current values (A) take non-linear effects into account.

21-apr-1993.
L. Durieu.

Magnet	T11QDE01	T11QFO02	T11BHZ01	T11QFO03	T11BHZ02	T11QFO04	T11QDE05	T11BVT02
Supply	R2g 08	R2g 06	R3 01	R1 18	R2 04	R2 12	R2 07	R2 09
Momentum								
GeV/c								
1.0	97.2	85.8	209.6	65.9	153.8	87.0	81.9	41.2
1.2	116.7	102.9	251.5	79.1	184.6	104.4	98.3	49.4
1.4	136.1	120.1	293.3	92.2	215.4	121.9	114.7	57.6
1.6	155.6	137.2	335.1	105.3	246.5	139.4	131.1	65.8
1.8	175.0	154.4	376.8	118.4	277.9	156.9	147.6	74.0
2.0	194.5	171.6	418.6	131.5	309.7	174.4	164.1	82.2
2.2	214.0	188.7	460.4	144.5	342.2	192.1	180.7	90.3
2.4	233.4	205.9	502.4	157.6	375.5	209.8	197.3	98.5
2.6	252.9	223.1	544.6	170.6	410.1	227.7	214.1	106.6
2.8	272.4	240.3	587.4	183.7	446.5	245.7	230.9	114.7
3.0	291.8	257.4	630.9	196.8	485.3	263.8	247.8	122.8
3.2	311.3	274.6	675.7	209.8	527.7	282.2	265.0	131.0
3.4	330.8	291.8	722.6	223.0	575.6	300.8	282.3	139.1
3.6	350.3	309.0	773.3	236.2	632.6	319.8	299.8	147.1

Table 16.
Magnet settings for beam T11,
nominal focus.

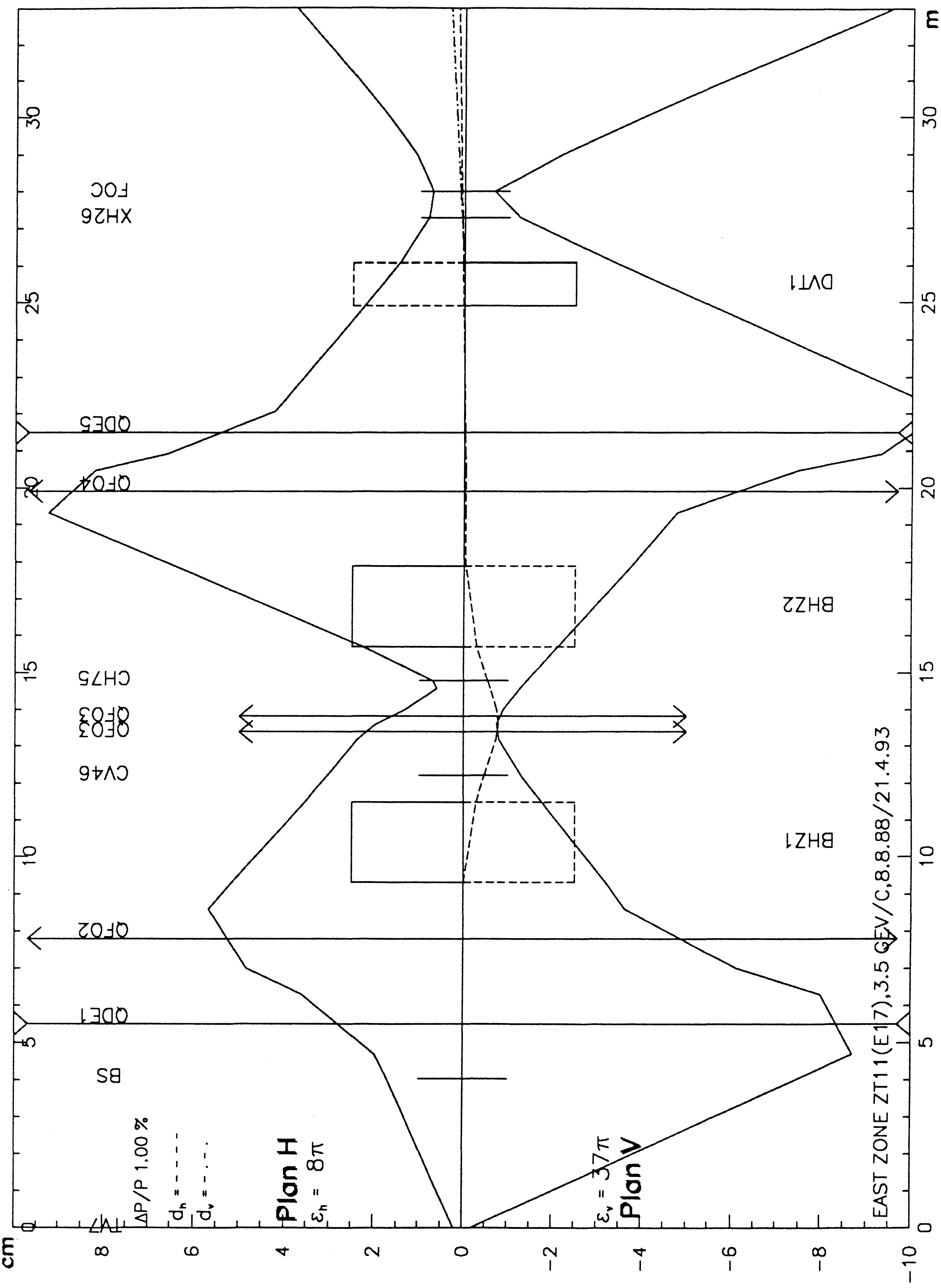

Fig. 24 : Nominal optics for beam T11

Current values (A) take
non-linear effects into account.

21-apr-1993.
L. Durieu.

Magnet	T11QFO04	T11QDE05	T11QFO04	T11QDE05	T11QFO04	T11QDE05	T11QFO04	T11QDE05
Momentum *GeV/c*	0 m		+5 m		+10 m		+15 m	
1.0	87.0	81.9	79.3	67.8	75.7	62.1	73.6	59.0
1.2	104.4	98.3	95.2	81.4	90.8	74.6	88.3	70.9
1.4	121.9	114.7	111.1	94.9	106.0	87.0	103.0	82.7
1.6	139.4	131.1	127.0	108.5	121.2	99.4	117.8	94.5
1.8	156.9	147.6	143.0	122.1	136.4	111.9	132.6	106.3
2.0	174.4	164.1	158.9	135.7	151.6	124.4	147.4	118.2
2.2	192.1	180.7	175.0	149.4	166.9	136.9	162.2	130.0
2.4	209.8	197.3	191.0	163.1	182.2	149.4	177.1	141.9
2.6	227.7	214.1	207.2	176.8	197.6	161.9	192.0	153.8
2.8	245.7	230.9	223.5	190.5	213.1	174.4	207.0	165.7
3.0	263.8	247.8	239.8	204.3	228.6	187.0	222.0	177.7
3.2	282.2	265.0	256.3	218.2	244.2	199.7	237.2	189.7
3.4	300.8	282.3	273.0	232.1	260.0	212.4	252.5	201.7
3.6	319.8	299.8	289.8	246.2	276.0	225.1	267.9	213.7

Table 17.
Focus adjustment in
the beam T11.

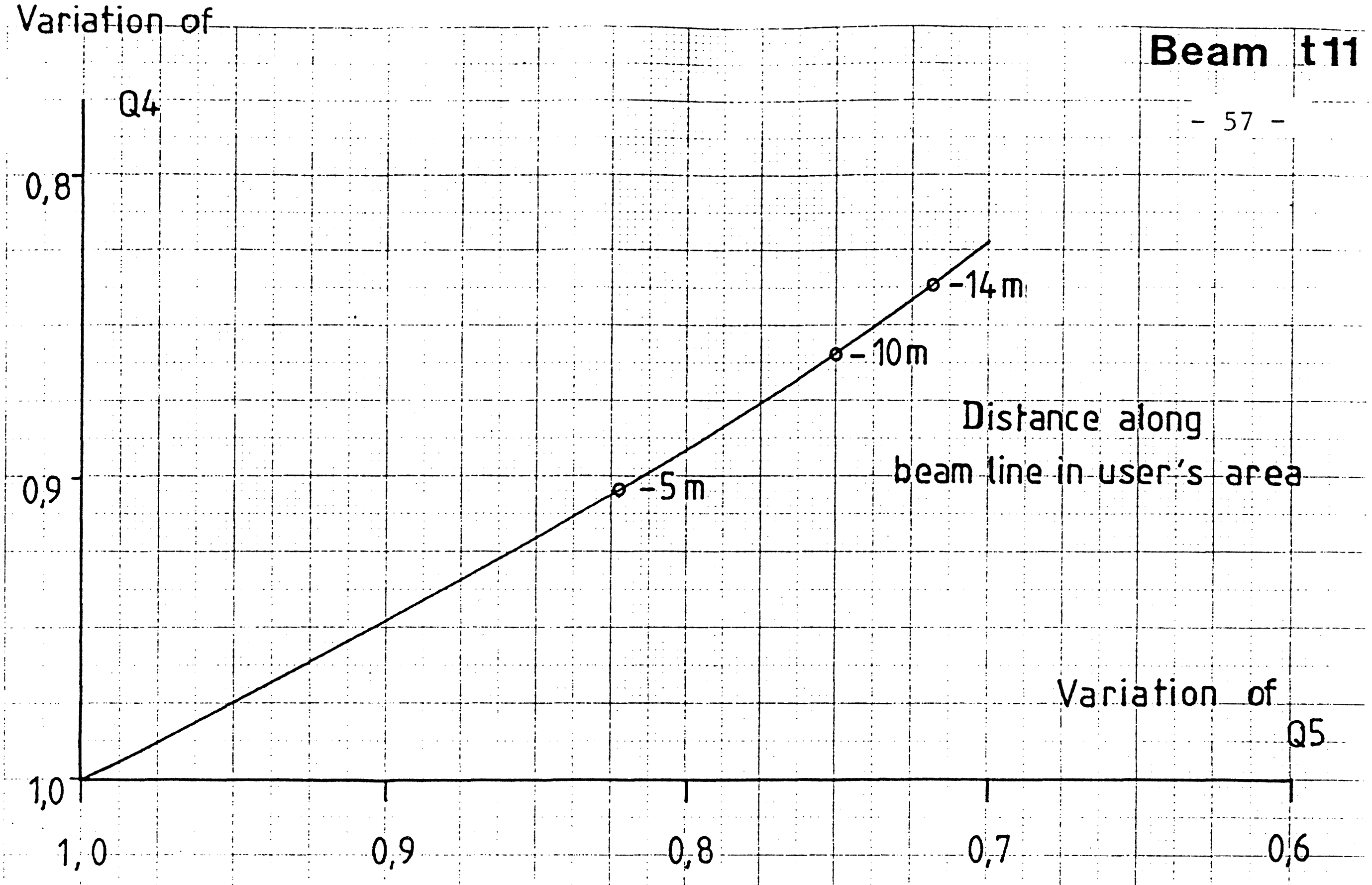

Fig.25 _DISPLACEMENT OF BEAM WAIST IN USER'S AREA; FACTORS FOR VARIATION OF Q4 AND Q5.

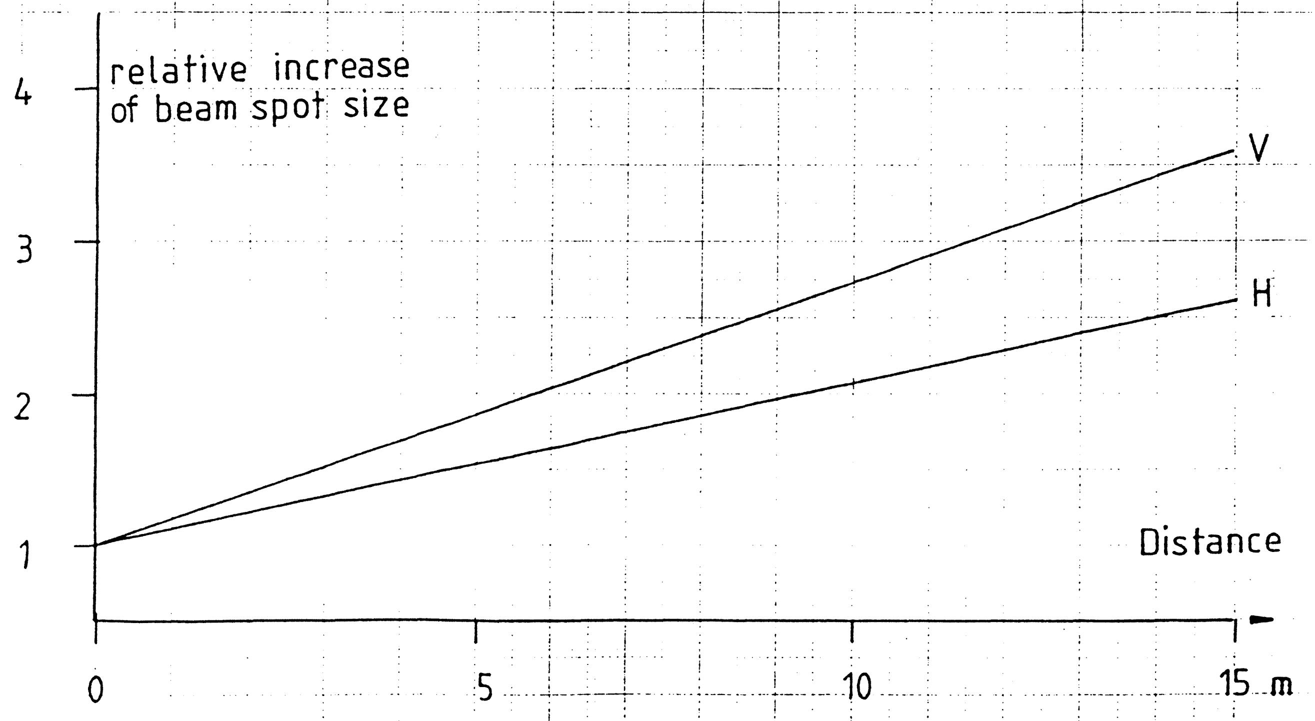

Fig.26 _RELATIVE INCREASE OF BEAM SPOT SIZE IN USER'S AREA. (without scattering).

Beam t11

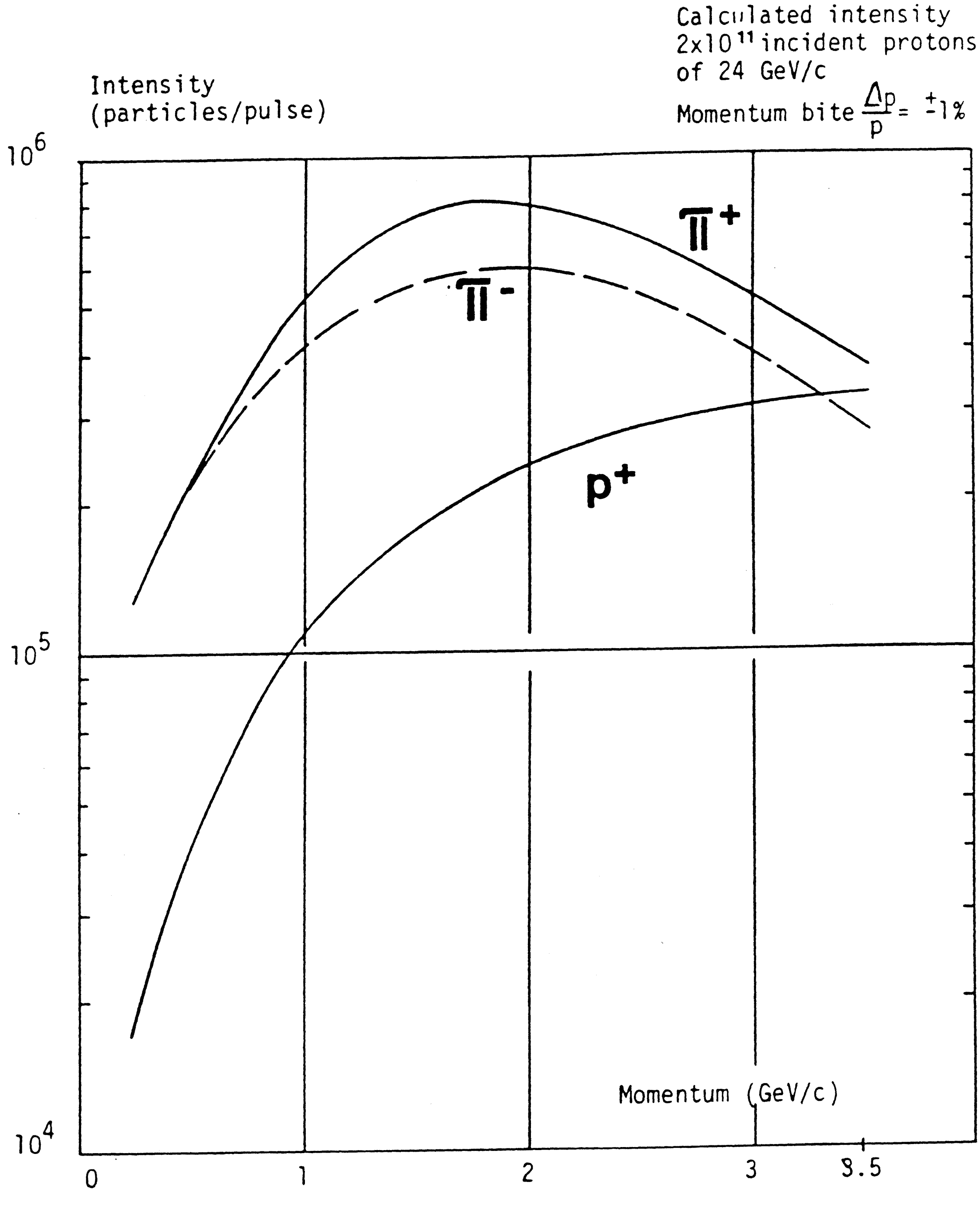

Fig. 27 : Calculated intensity at the reference focus of t11.

Beam t11

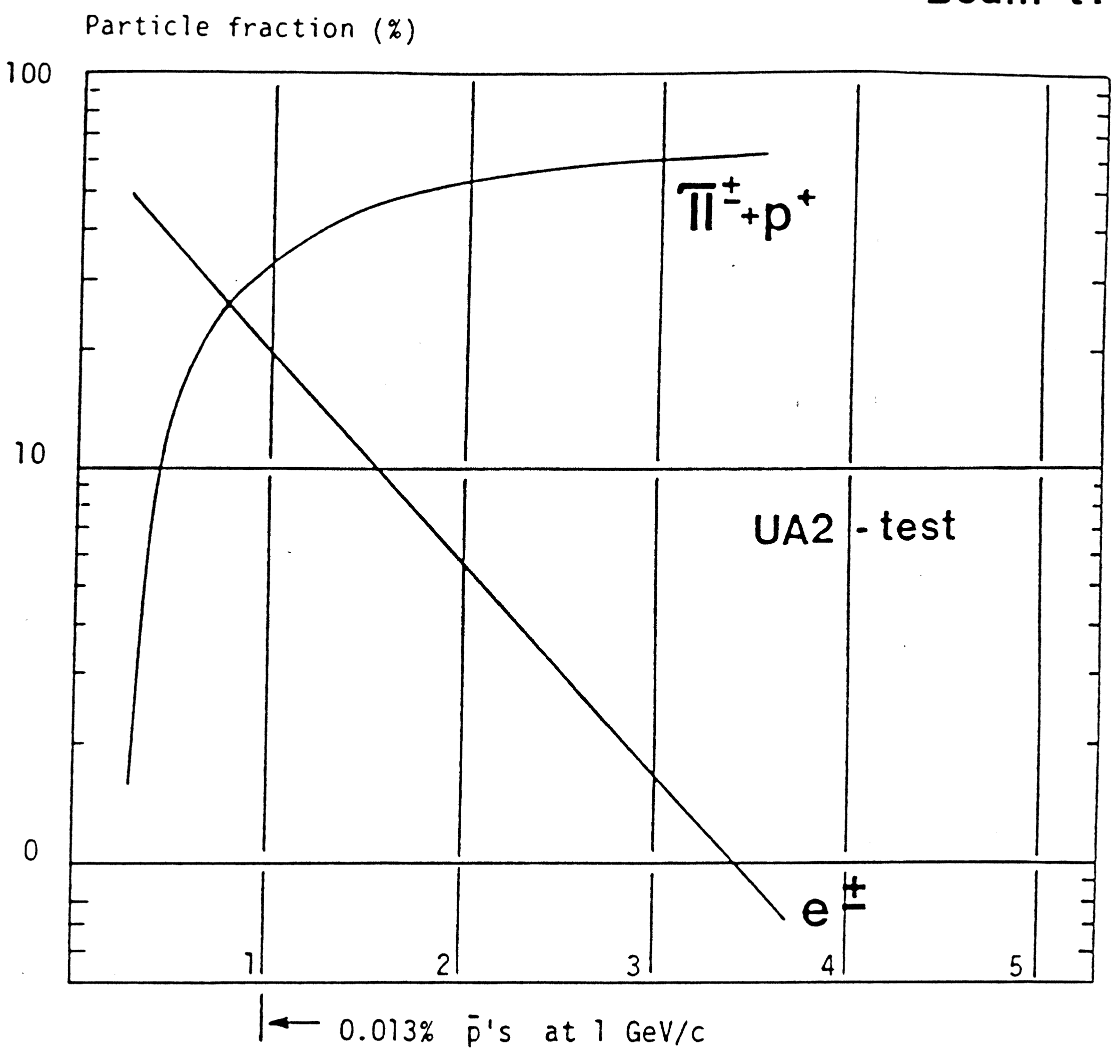

Fig. 28 Observed particle fractions in the t11 beam (particle identification by 2 Čerenkov counters + 1 pre-shower detector) UA2-test (1987)