πE1 secondary beam line

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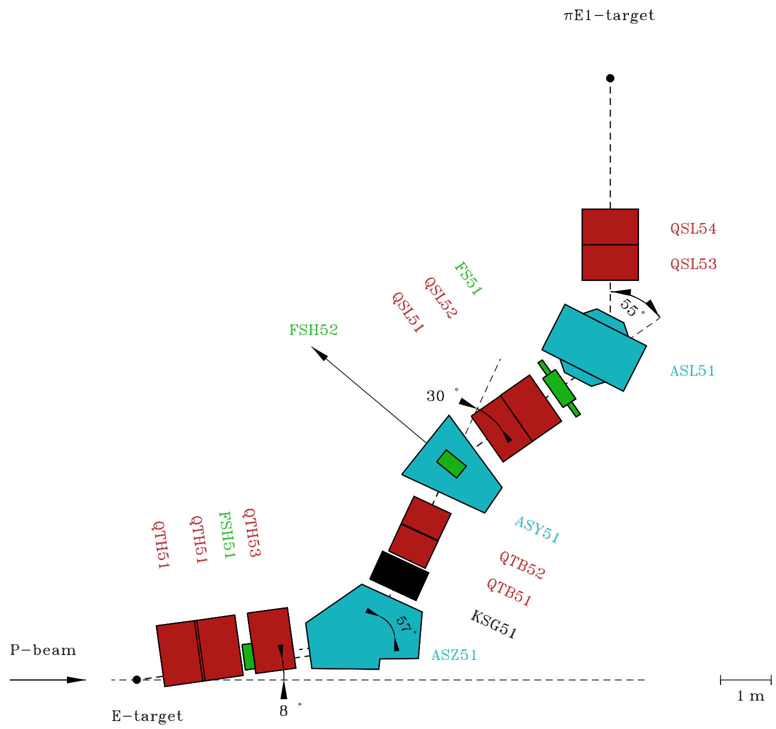
πE1



πE1

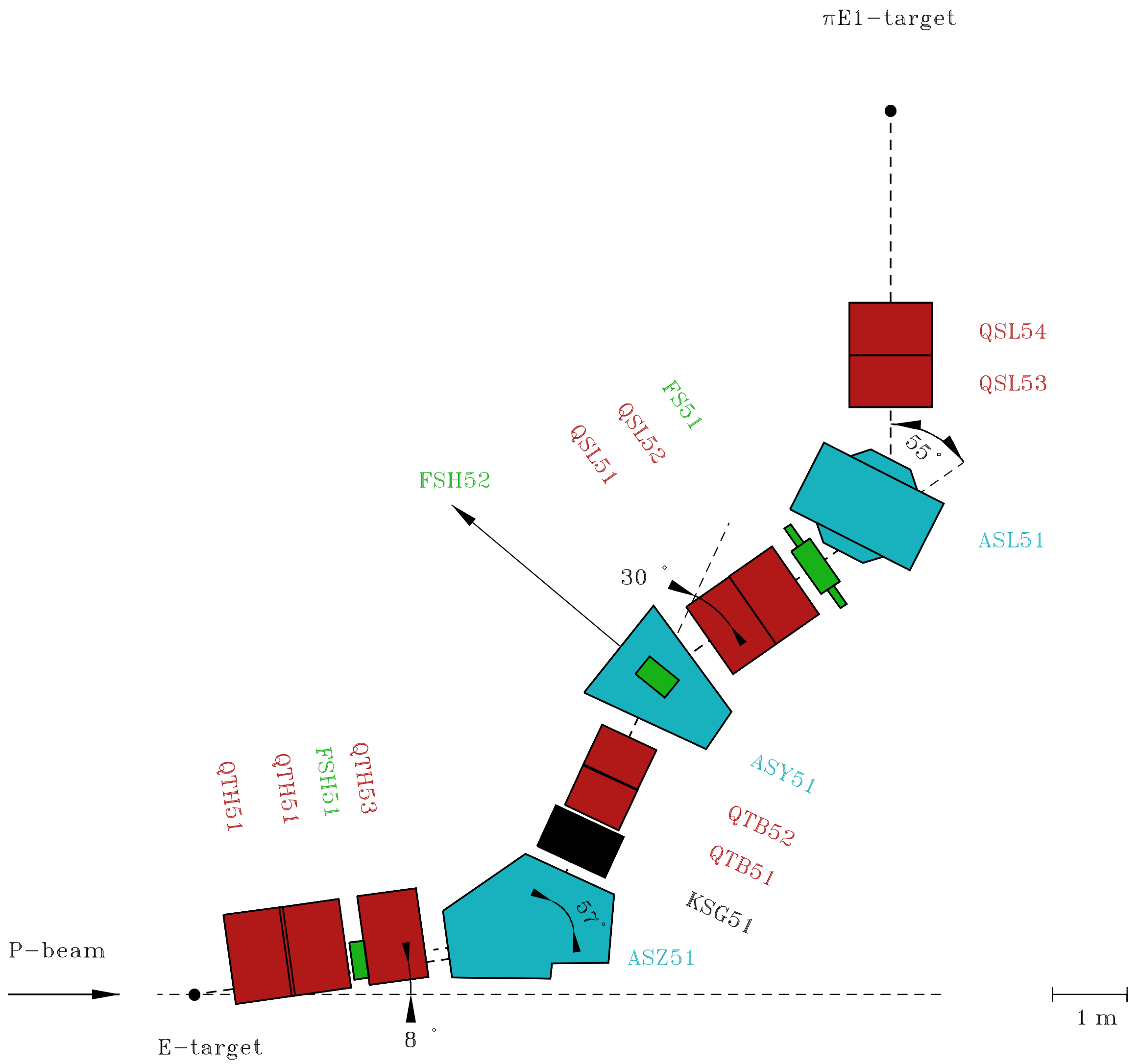


Figure 1: πE1 beam line

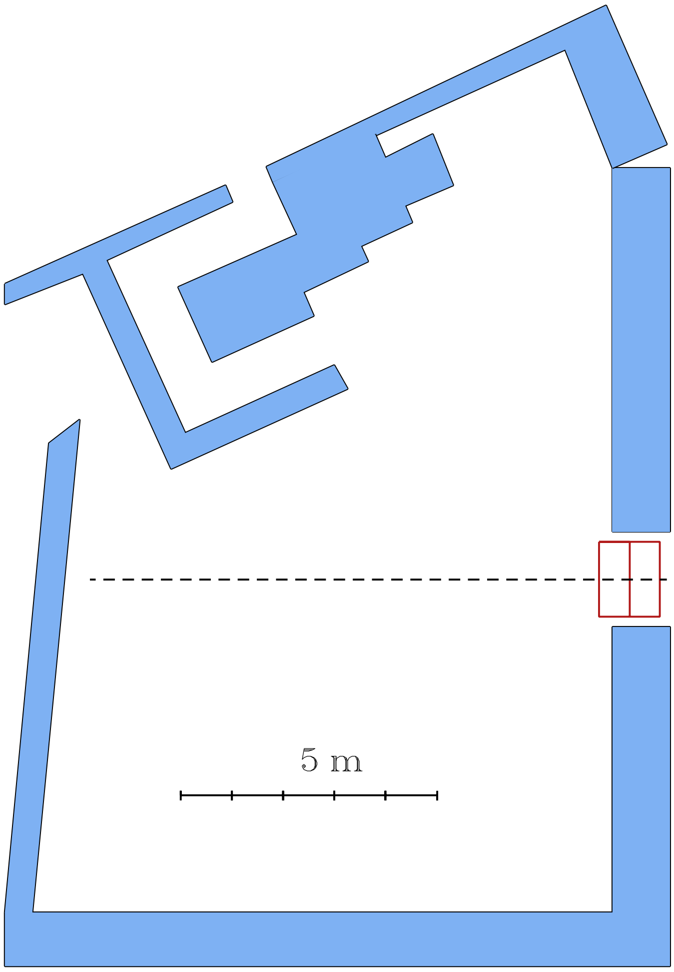


Figure 2: Lyout of the πE1 area

1 The πE1 beam line

The πE1 beam line is a high intensity π and μ beam with a momentum range from 10 to 500 MeV/c. The particles from the thick target station are extracted in the forward direction under an angle of 10^0. In order to obtain a large angular acceptance half quadrupoles with pole tip radii of 20 cm are used as the first focussing elements of the beam line. Two optical modes of operation are avaliable :

- Mode **A** provides high fluxes with low momentum resolution and its momentum range is limited by the focussing strength of the first quadrupoles to values lower than 280 MeV/c
- Mode **B** is a low acceptance, high momentum resolution version with mometa up to 500 MeV/c

The characteristics of the beam line are summarized in the following table.

	Beam characteristics					
Mod	P_{max} [MeV/c]	$\Delta\Omega$ [msr]	$\Delta p/p$ slits open [% FWHM]	$\Delta p/p$ slites closed [% FWHM]	π^+/s mA 200 MeV/c $\delta p/p=\pm1\%$	stop density [π^+/g mA s]
A	280	32	7.8	0.8	$5\,10^8$	$2.5\,10^7$
B	500	13	8.0	0.26	$5\,10^7$	$1.0\,10^7$

The measured muon rates around 28 MeV/c are shown in fig 3 and the measured pion flux in fig 4.
Without an electrostatic separator the positive μ to positron ratio amounts to $e^+/\mu^+ = 50$. The use of a short crossed-field separator ($l_{eff} = 0.7$ m , E = 150 kV/13 cm, transmition $\simeq$ 80 %) and a subsequent quadrupole doublet reduces this contamination to a level of few percent.
There are three slits[1] systems in the beam line to control either the beam intensity by reducing the angular acceptance of the beam, or the momentum band acceptance, hence the momentum resolution of the transported beam.
The measured π beam profiles are shown in figure 5.

[1]FSH52 and FSH51on fig 1

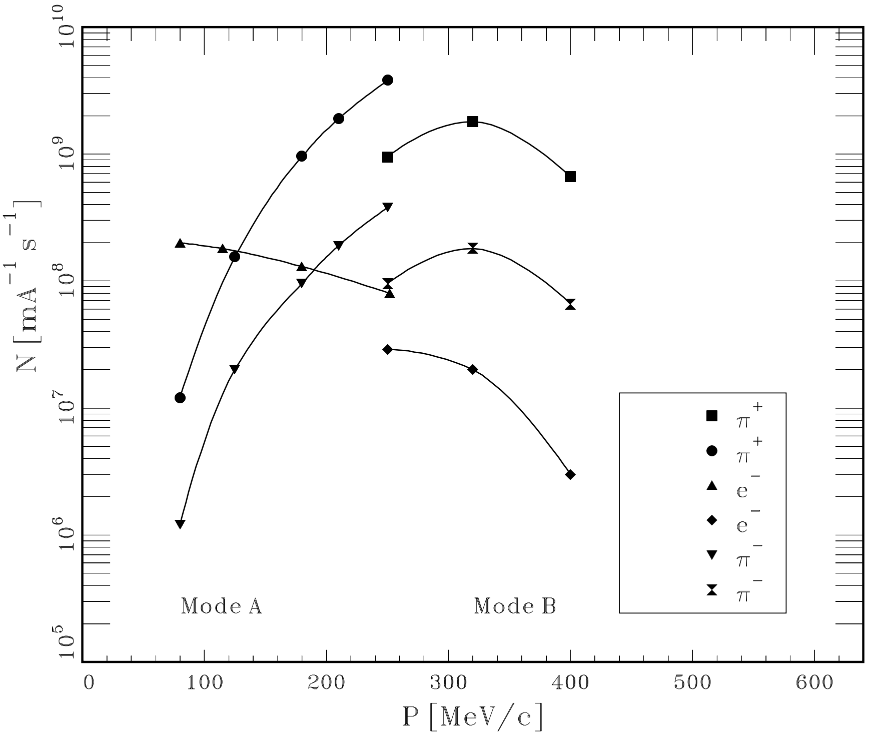


Figure 3: π and e fluxes

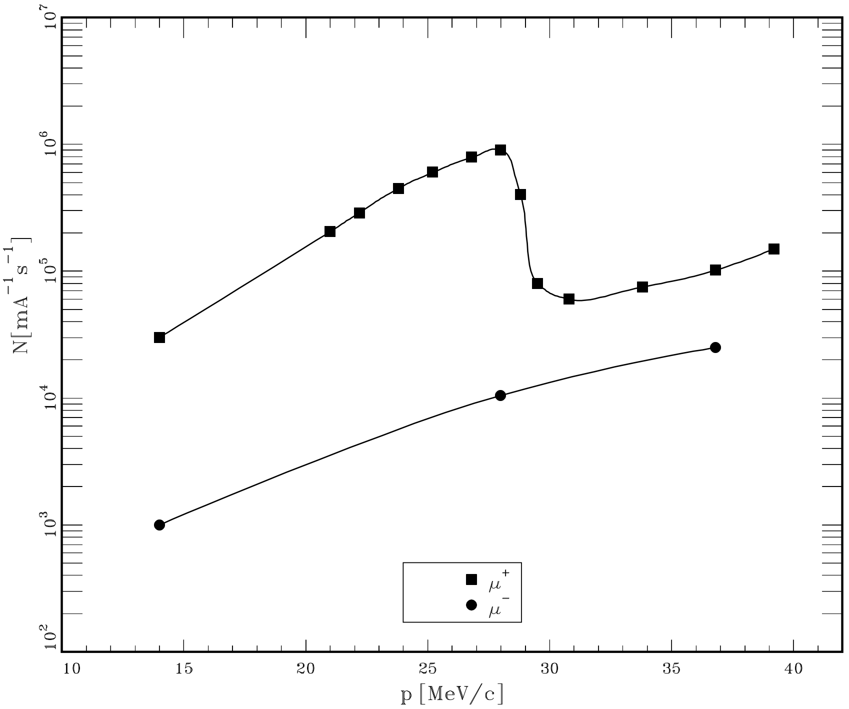


Figure 4: μ flux

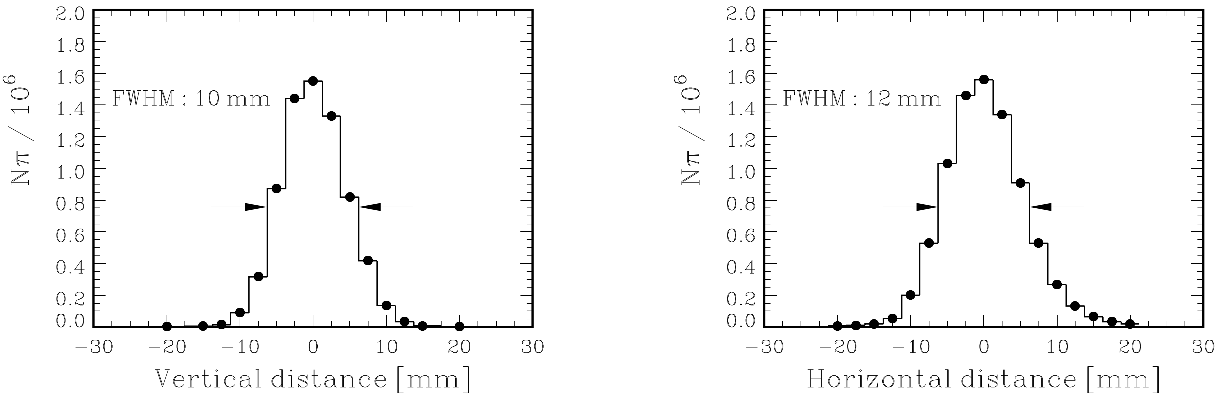
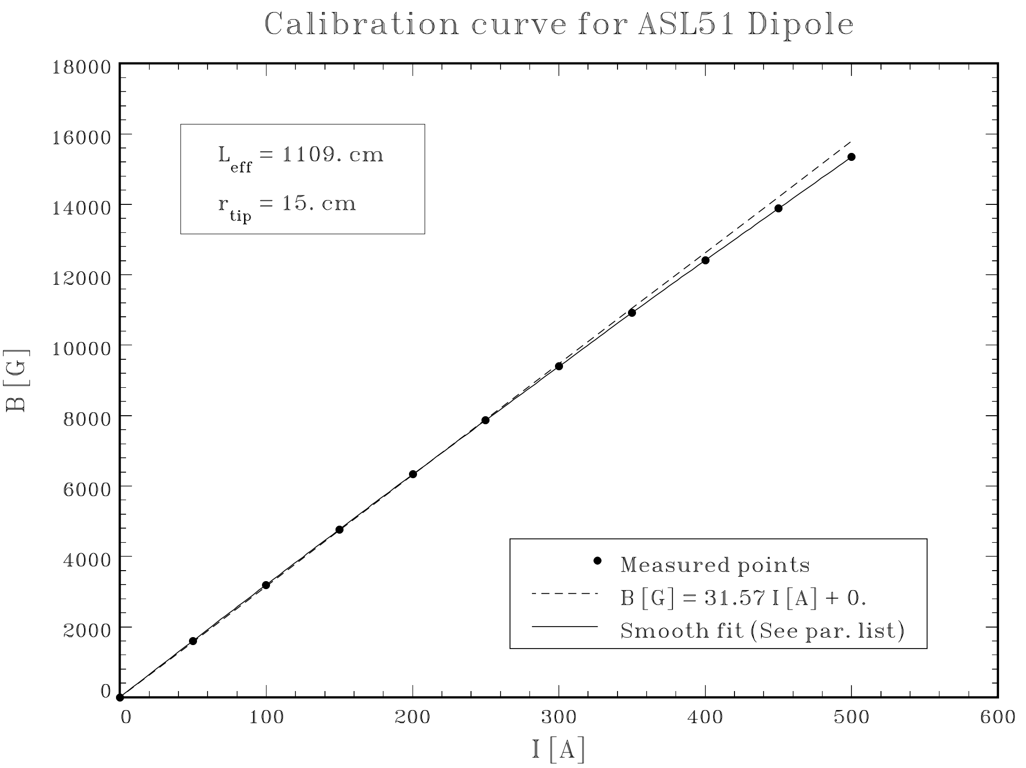
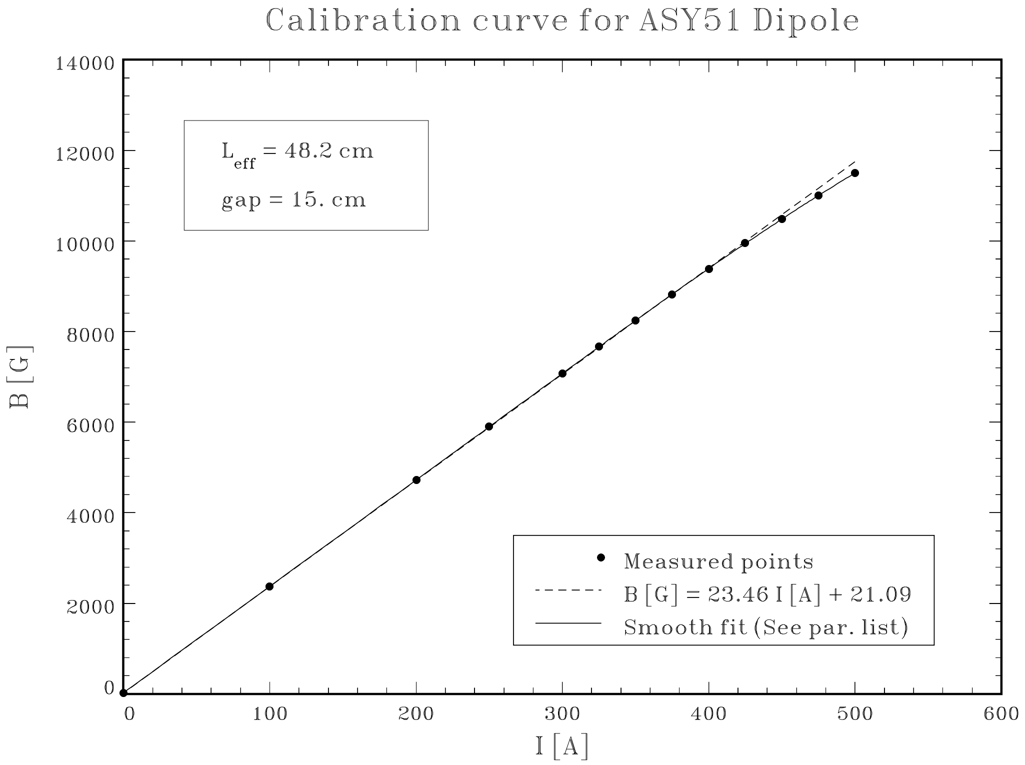
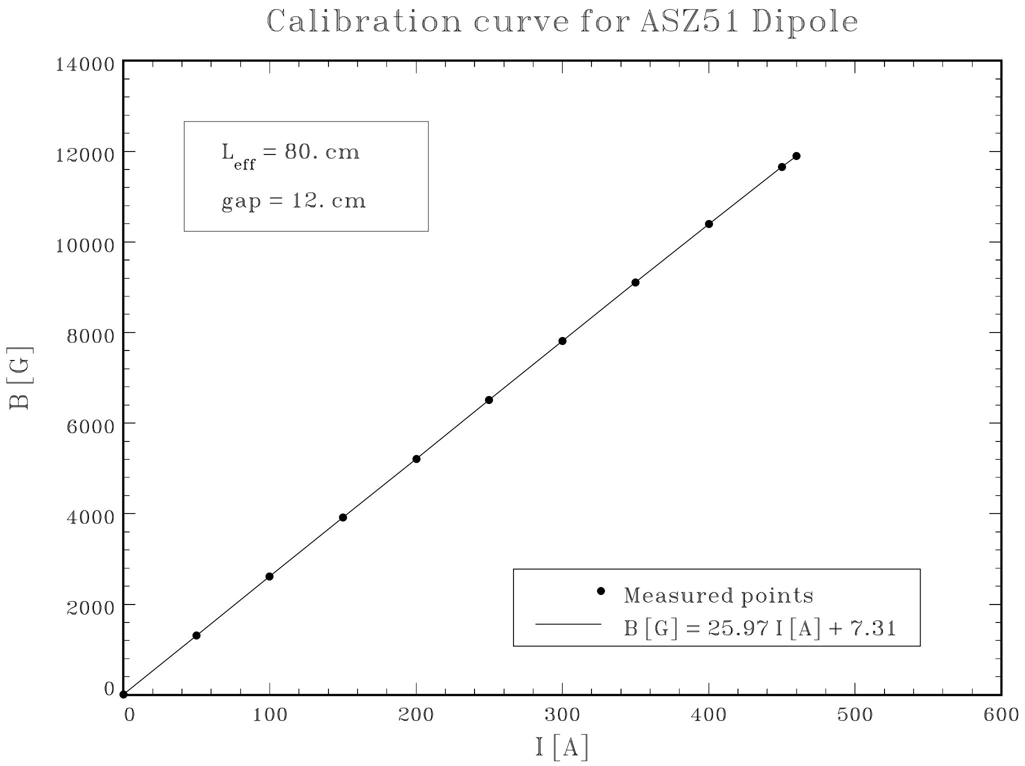


Figure 5: π profils





Calibration curve for ASY51 Dipole
L_{eff} = 48.2 cm
gap = 15. cm
Measured points
B [G] = 23.46 I [A] + 21.09
Smooth fit (See par. list)
B [G]
I [A]
0
2000
4000
6000
8000
10000
12000
14000
0
100
200
300
400
500
600

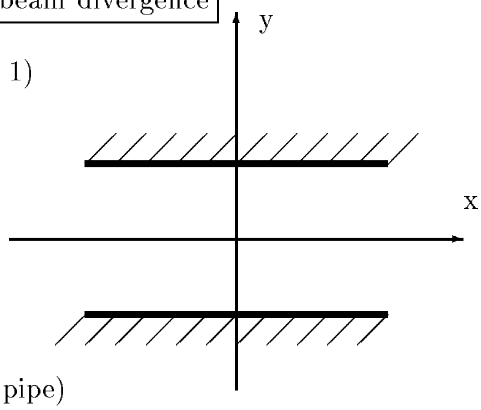


Calibration curve for ASZ51 Dipole
L_{eff} = 80. cm
gap = 12. cm
Measured points
B [G] = 25.97 I [A] + 7.31
B [G]
I [A]
0
2000
4000
6000
8000
10000
12000
14000
0
100
200
300
400
500
600

πE1 slits

FSH51

Reduces **vertical** beam divergence



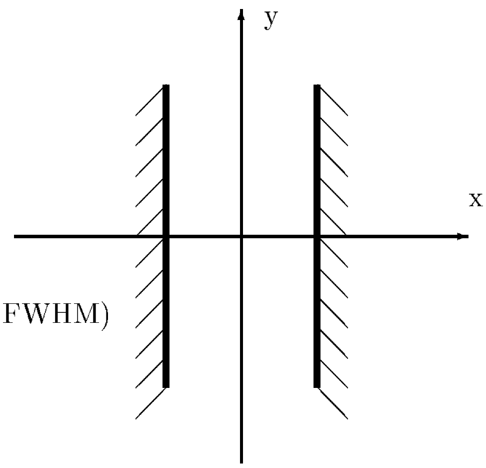
Located between QTH52 and QTH53 (see fig 1)
Collimates **vertical** size of beam
Maximal opening ± 25 cm (i.e, 50 cm)
Calibration :

$$y \; = \; \pm 25 \times \frac{\mathrm{DAC} - 50}{750} \;\; cm$$

The two jaws move simultaneously.
Y (center of opening) = Y (center of the vacuum pipe)

FSH52

Reduces beam **momentum** bite



Located in ASY51 (see fig 1)
Collimates **horizontal** size of beam
Maximal opening ± 15 cm (i.e, 30 cm)
Calibration :

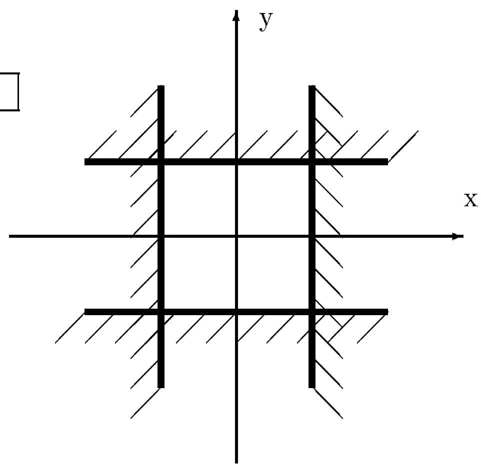
$$x \; = \; \pm 15 \times \frac{\mathrm{DAC} - 50}{900} \;\; cm$$

Beam dispersion $\simeq$ 5 cm/%
E,g DAC = 350 ; X = $\pm$ 5 cm ; $\frac{\Delta p}{p}$ = 1% (2 % FWHM)

The two jaws move simultaneously.

FS51

Cuts off beam **halo**



Located between QSL52 and ASL51 (see fig 1)
Collimates **horizontal** <u>and</u> **vertical** size of beam
Maximal opening ± 15 cm (i.e, 30 cm)
Calibration :

$$x \text{ or } y \; = \; \pm \frac{\mathrm{DAC} - 50}{900} 15 \;\; cm$$

The four jaws move independently.

1.1 Some other informations

- The beam's higt is 150.5 cm
- If an end beam window is needed, it is of Mylar and has usually 150 μm
- The standard beam pipe diameter is 320 mm

In case of problems contact :

- for **electricity** : A Widmer , M Horvat
- for **cooling water** : Markus Koller
- for **beam setting** : U Rohrer
- for **vacuum system** : U Kalt
- for **Experimental hall** : H Vetterli
- for **SU** : W Wittwer

1.2 On beam setting

There are **two** PC available for πE1 beam line :

$$\begin{cases} \text{PC 484} & \text{located in the } \pi\text{E1 barracq} \\ \text{PC 130} & \text{located on the gallery in a CAMAC crate} \end{cases}$$

You work with the PC 484, using mainly the **SETPOINT** facility.
The corresponding CAMAC address and magnet identification are in the : **device.lis** file (in OPTIMA).If you change the device.lis, start SETPOINT again. You might have setting saved in a**.set** file (in SETPOINT) , which can be loaded, or created.

However :

If you have to change the **device.lis** file, you have to do it **in** the **PC130**

More information are to be found in :

http://www.psi.ch/~Rohrer/secblctl.html

For this go into the PSI home page : http://www.psi.ch and click on Departments and Projects , and then on Experimental Facilities (AEA) and finally on Control system for secondary beam lines.

To convert from DAC value to Field value you can use the **Itune** programme. There is a manual for the **Tune** , **Itune** , **DAC_to_B** and **B_to_DAC** programme by F Foroughi.

Examples are given at the end.

The structure of the **device.lis** file is :

Device name	DAC-special	ROAD add	CAMAC station Nb	DAC min	DAC max	DAC-type	ADC-parameter	ROAD add	CAMAC ADC-CRCI	ADC-channel	Range	ADC-type	Scale (normal=1.0)	Precision DAC-ADC
QTH51	1	9	19	-4095	4095	0	0	15	19	13	0	0	1.000	0.150
QTH52	0	10	19	-4095	4095	0	0	15	19	17	0	0	1.000	0.150
QTH53	1	10	19	-4095	4095	0	0	15	19	15	0	0	1.000	0.150
ASZ51	0	8	19	-4095	4095	0	0	15	19	10	1	0	0.300	0.150
QTB51	0	3	19	-4095	4095	0	0	15	19	6	0	0	1.000	0.150
QSB52	1	4	19	-4095	4095	0	0	15	19	7	0	0	1.000	0.150
ASY51	0	9	19	-4095	4095	0	0	15	19	12	0	0	1.000	0.150
QSL51	0	4	19	-4095	4095	0	0	15	19	5	0	0	1.000	0.150
QSL52	1	3	19	-4095	4095	0	0	15	19	8	0	0	1.000	0.150
ASL51	1	5	19	-4095	4095	0	0	15	19	9	0	0	1.000	0.150
QSL53	1	1	19	-4095	4095	0	0	15	19	1	0	0	1.000	0.150
QSL54	0	1	19	-4095	4095	0	0	15	19	2	0	0	1.000	0.150
*														
SSK51	0	7	19	-4095	4095	0	0	15	19	21	1	0	0.060	0.150
QSK51	0	6	19	-4095	4095	0	0	15	19	20	0	0	1.000	0.150
QSK52	1	7	19	-4095	4095	0	0	15	19	19	0	0	1.000	0.150
QSL55	0	13	19	-4095	4095	0	0	15	19	22	0	0	1.000	0.150
Exp.MAG	0	3	21	0	65535	4	0	15	19	11	1	0	1.000	0.150
ASK51	0	1	21	0	65535	4	0	15	19	3	0	0	1.000	0.150
SSL51	0	2	19	-4095	4095	0	0	15	19	4	0	0	1.000	0.150
*														
FSH51	0	0	5	0	1000	9	1	0	5	0	0	9	4.095	0.050
FSH52	0	1	5	0	1000	9	1	1	5	0	0	9	4.095	0.050
DSC51	0	0	6	0	1000	9	1	0	6	0	0	9	4.095	0.050
DSC52	0	1	6	0	1000	9	1	1	6	0	0	9	4.095	0.050
FS51-O	0	0	7	0	1000	9	1	0	7	0	0	9	4.095	0.050
FS51-U	0	1	7	0	1000	9	1	1	7	0	0	9	4.095	0.050
FS51-L	0	0	8	0	1000	9	1	0	8	0	0	9	4.095	0.050
FS51-R	0	1	8	0	1000	9	1	1	8	0	0	9	4.095	0.050

A * means newpage.
Some magnets have the name of the power supply (QSK51-QSK52-QSL51-ASL71)

For more informations see the corresponding WWW pages!

Table I. Coefficients for the calibration of magnetic elements

$B = a_0 + a_1 I + a_2 I^2 + a_3 I^3 + a_4 I^4$ [B] = G ; [I] = A

	Coefficients				
Element	a_0	a_1	a_2	a_3	a_4
QTA	12.00	25.113	$-.2946\ 10^{-1}$	$+.182\ 10^{-3}$	$-.36\ 10^{-6}$
QTB	1.933	16.011	$-.7186\ 10^{-2}$	$+.432\ 10^{-4}$	$-.63\ 10^{-7}$
QTD	1.933	16.011	$-.7186\ 10^{-2}$	$+.432\ 10^{-4}$	$-.63\ 10^{-7}$
QTH	7.647	18.10	$-.4520\ 10^{-2}$	$+.333\ 10^{-4}$	$-.61\ 10^{-7}$
QSB	0.	17.066	$+.9412\ 10^{-2}$	$-.361\ 10^{-4}$	$+.10\ 10^{-7}$
QSE	.1541	14.125	$+.4991\ 10^{-2}$	$-.132\ 10^{-4}$	
QSF	.8402	9.1893	$-.3735\ 10^{-2}$	$+.254\ 10^{-4}$	$-.32\ 10^{-7}$
QSL	0.	18.092	$+.4228\ 10^{-3}$		
QSK	7.135	18.2460	$-.9022\ 10^{-2}$	$+.528\ 10^{-4}$	$-.79\ 10^{-7}$
HSA	13.47	62.384	$-.2505\ 10^{+0}$	$-.225\ 10^{-2}$	
HSB	13.47	62.384	$-.2505\ 10^{+0}$	$-.225\ 10^{-2}$	
HSC	1.145	9.2268			
HSD	12.33	9.6336	$+.4849\ 10^{-1}$	$-.279\ 10^{-3}$	$+.37\ 10^{-6}$
ASK*	10.02	25.722	$+.1256\ 10^{-1}$	$-.341\ 10^{-4}$	
ASK**	7.51	19.291	$+.9420\ 10^{-2}$	$-.256\ 10^{-4}$	
ASL	0.	32.256	$-.3116\ 10^{-2}$		
ASM	7.31	25.967			
ADT	1.83	12.445			
ASX	3.91	21.382	$+.1040\ 10^{-1}$	$-.223\ 10^{-4}$	
ASY	20.8	23.974	$-.1655\ 10^{-2}$		
ASZ	7.31	25.967			

* ASK 61,62,71,72,81 and 82 ; ** ASK 31 and 32

21-MAR-96

Setting for πE1

$P\ =\ 130.$ MeV/c Particle : $\boldsymbol{\pi^+}$ Mode : **Example**

Elements	B [KG]	I [A]	DAC	$\frac{\text{I}}{\text{Imax}} \cdot \frac{100}{\text{r}}$	r Range factor	Imax [A]
QTH 51	-3.1569	-175.19	-1435	0.35	100	500
QTH 52	1.5646	86.65	710	0.173	100	500
QTH 53	-0.0135	-0.33	-3	0.001	100	500
ASZ 51	6.8938	264.62	2167	0.529	100	500
QTB 51	-0.13	-8.14	-67	0.016	100	500
QTB 52	0.5005	31.71	260	0.063	100	500
ASY 51	6.4313	272.69	2233	0.545	100	500
QSL 51	1.0625	58.69	481	0.117	100	500
QSL 52	-0.2603	-14.38	-118	0.029	100	500
ASL 51	6.4313	203.44	1666	0.407	100	500
QSL 53	-0.4484	-24.77	-203	0.05	100	500
QSL 54	0.9724	53.71	440	0.107	100	500

Example for QTH 51 : $\frac{|\text{I}|}{\text{Imax}} \times \frac{100}{\text{r}} = \frac{|-175.19|}{500} \times \frac{100}{100} = 0.35$

$\frac{-175.19}{500} \times \frac{100}{100} = -0.3504 \rightarrow \text{DAC} = -0.3504 \times 4095 = -1435$