WS on Hadron Beam Line Technology
11-12 May, 2007

K1.1 beam line

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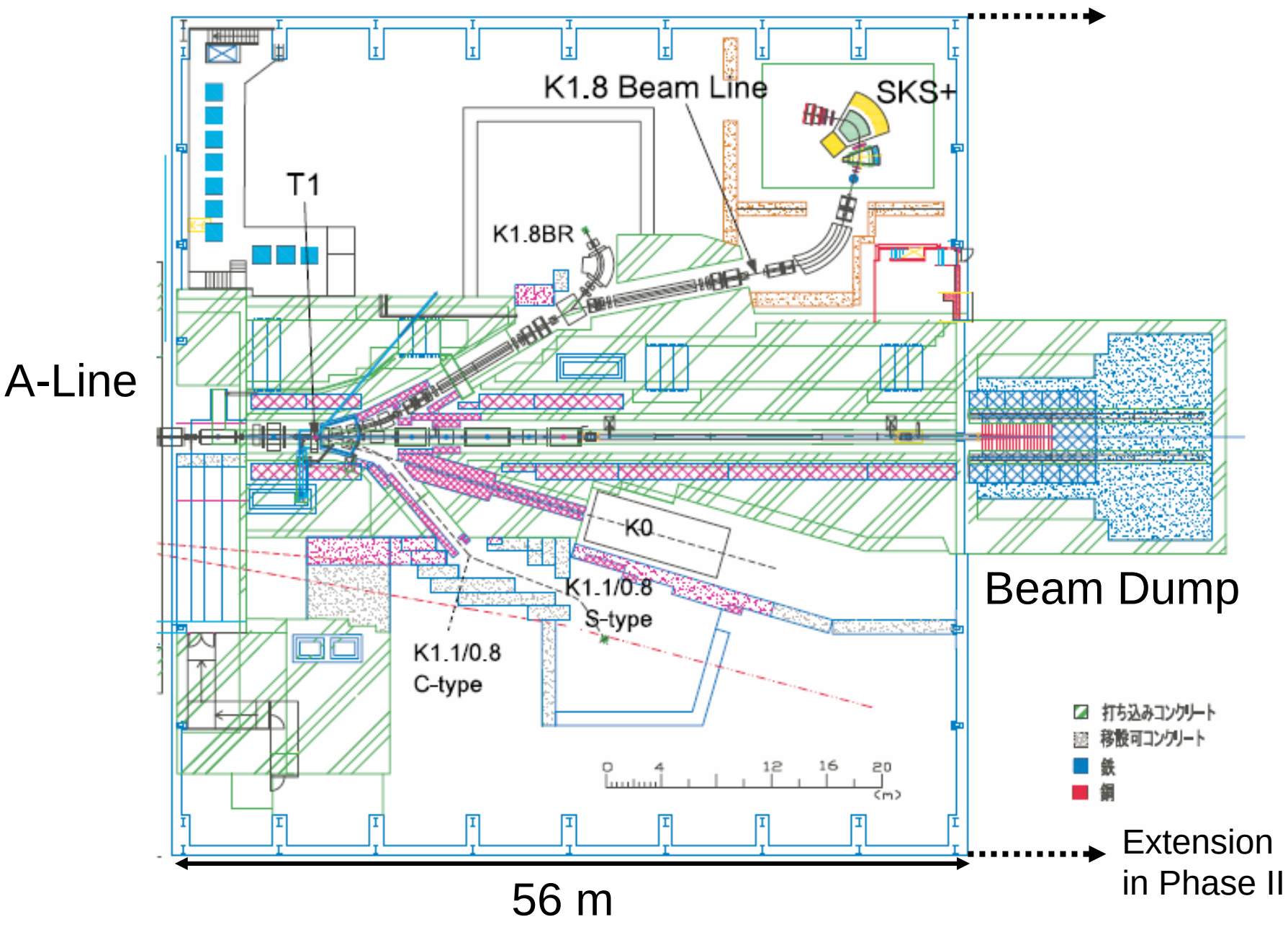
- K1.1 configuration - outline -
- Prospect

K1.1 configuration
- outline -

- Design
  Design goal/Layout and Concept
- Optics
  Beam envelope/Profile@FF
- Performance
  K purity/Intensity

Hadron Experimental Hall (Phase I)



K1.1 design

Design Goal

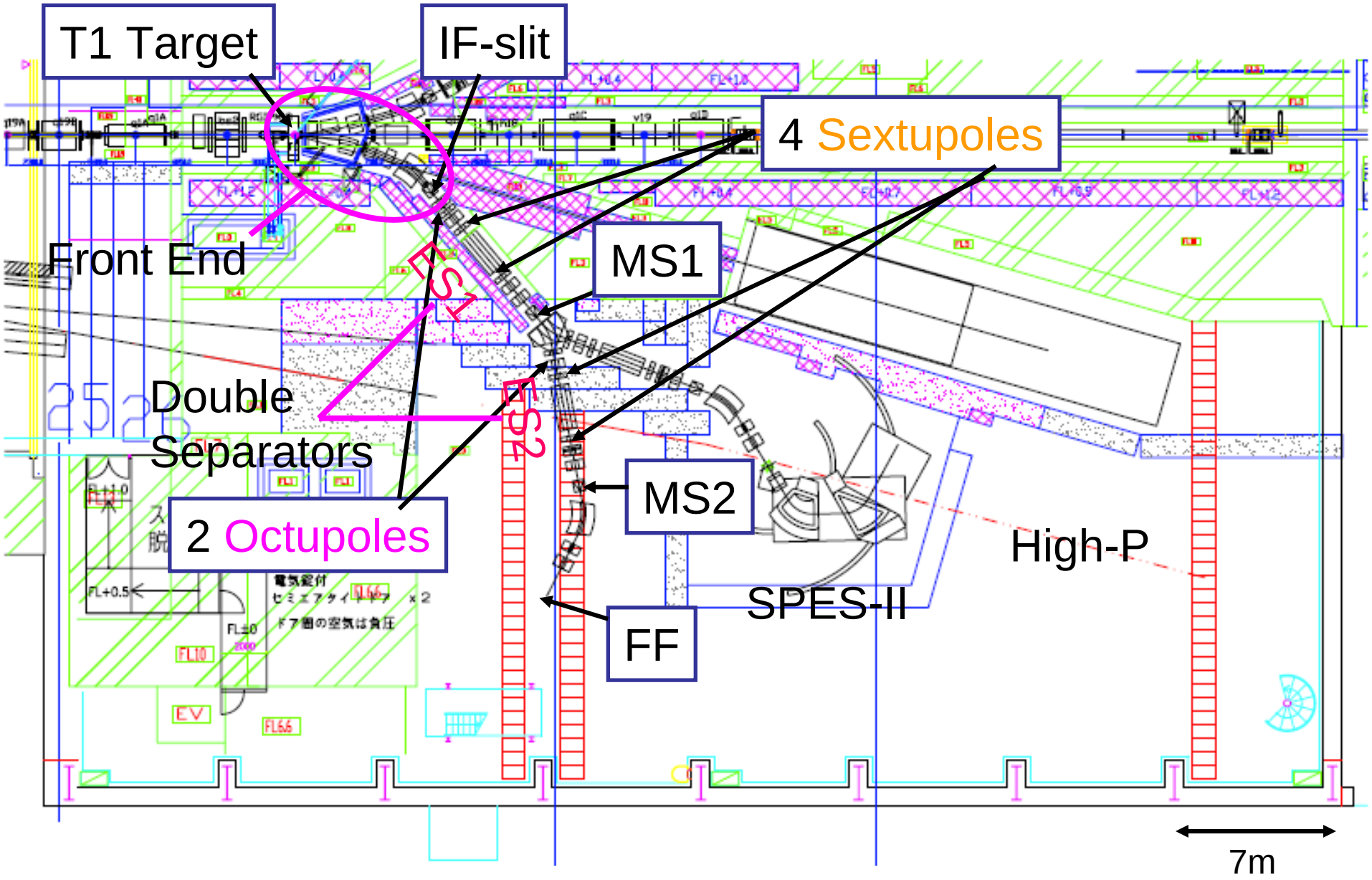
- ✓ Optimized for Λ hypernuclear spectroscopy
- ✓ Max. Central Momentum of K1.1: ~ 1.1 GeV/c
  since spin-flip amp. in (K-,π-) is max. at 1.1 GeV/c
- ✓ Intense K- at 1.1 GeV/c: ∼10^7 ppp for 50GeV-15μA
  30 GeV-9μA is a target specification in Phase I
- ✓ Pure K- at 1.1 GeV/c: K/π>>1 at FF
  Better K/π even at MS2 for beam line counters
- ✓ Required a Beam Momentum Analyzer at the end
  of K1.1.

K1.1 design

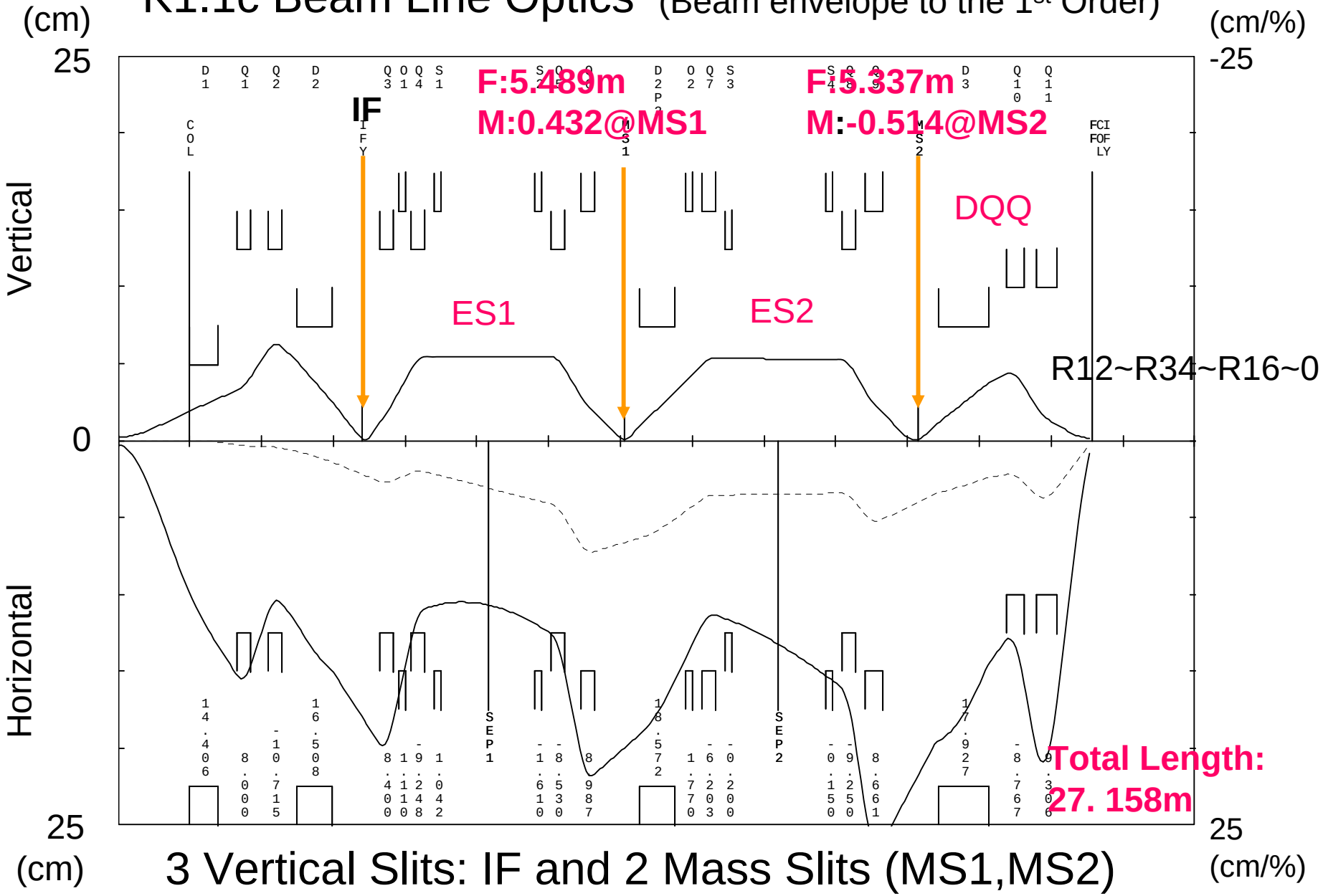
Layout and Concept

- ✓ Front End Section
  - 2ndary Beam Extraction at 6 deg. (opposite to K1.8)
  - Thermal protections/ Rad-Hard Equipments
    - Cu collimator before D1 (2m drift space from T1)
    - Magnet Operation in a Vacuum Chamber
- ✓ 1st and 2nd Separation Sections
  - Double Stage Separation : Wein Filter (ExB) Type of ES
  - 3 vertical Slits for Kaon purification
  - Higher order corrections to the 3rd order
    - 4 6-poles & 2 8-poles for vertical focus at MS1 & MS2
- ✓ Beam Analyzing Section
  - Room to place tracking chambers at the entrance & exit of a DQQ system.
  - Focus on FF: R12~R34~R16~0
- ✓ C-type Layout High-P beam line crosses

Configuration layout of K1.1c (Max. 1.1 GeV/c)

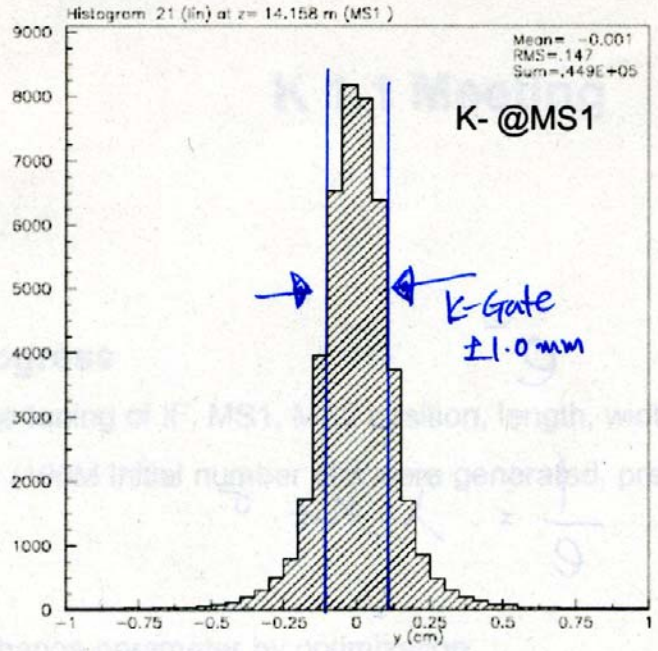


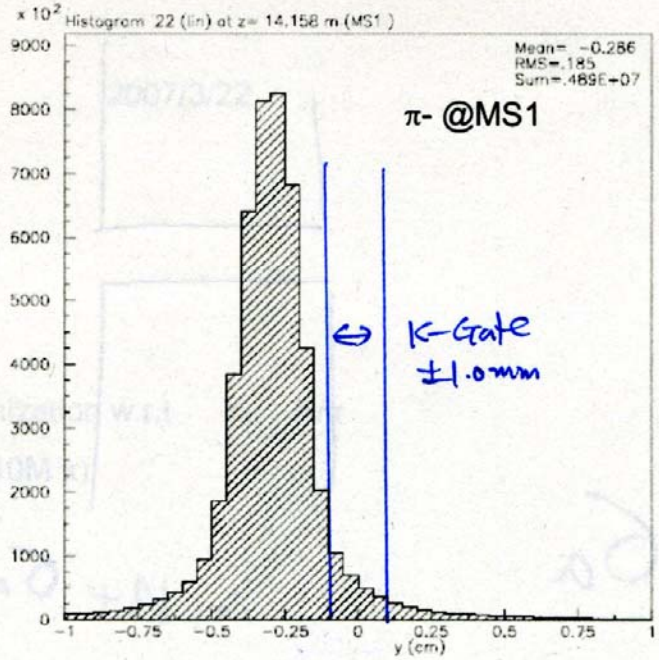
K1.1c Beam Line Optics (Beam envelope to the 1st Order)

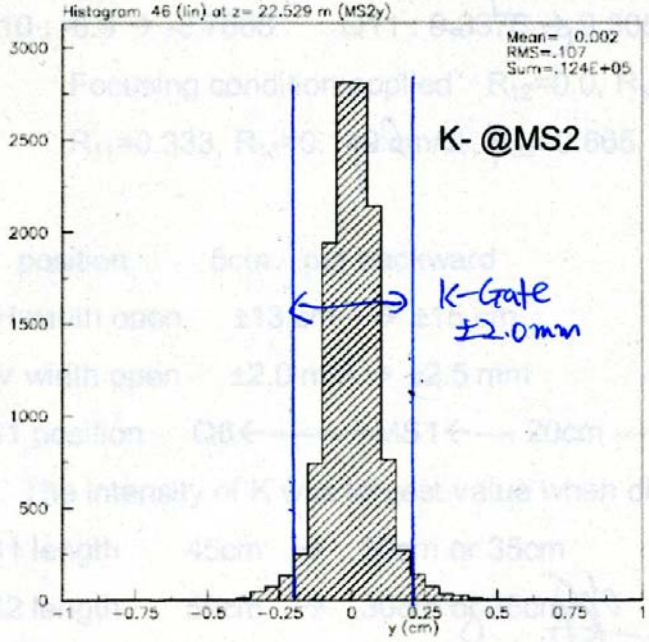


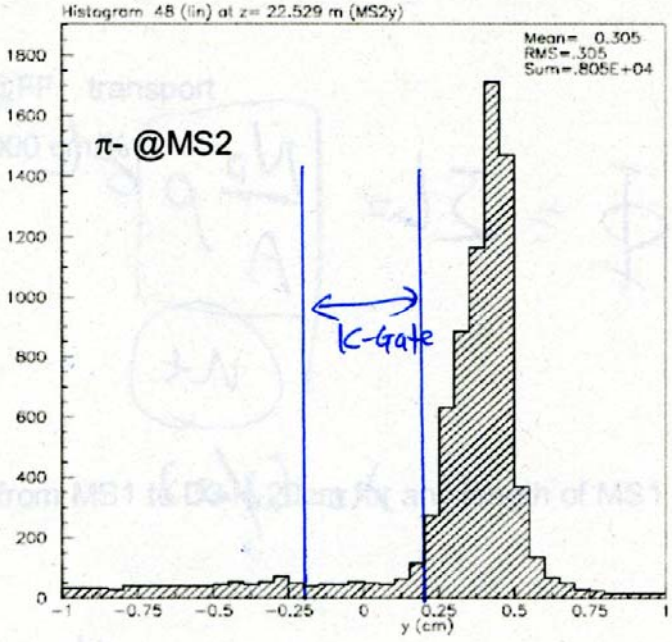
3 Vertical Slits: IF and 2 Mass Slits (MS1,MS2)
to purify kaon beam with 2 Electrostatic Separators

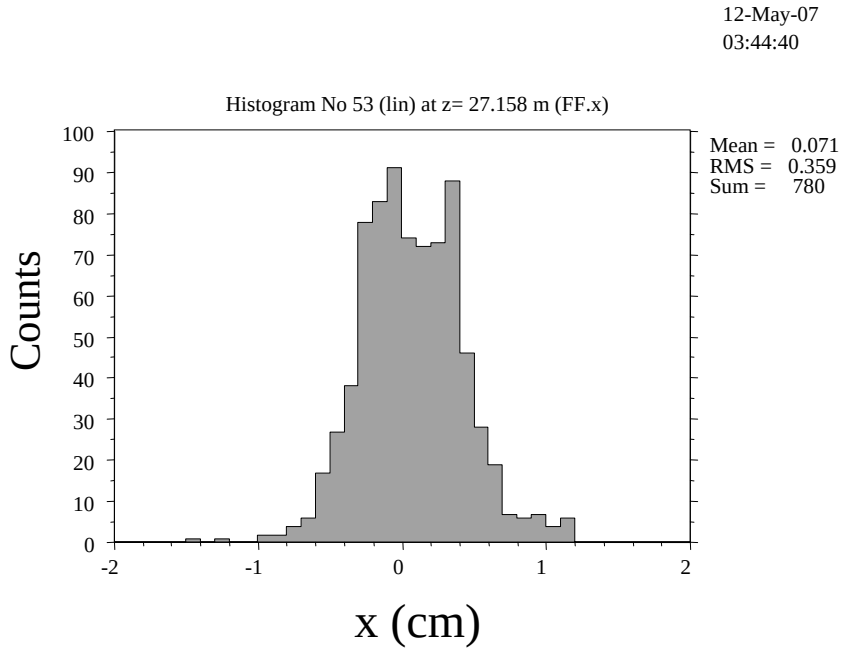
K/π separation at MS1, MS2

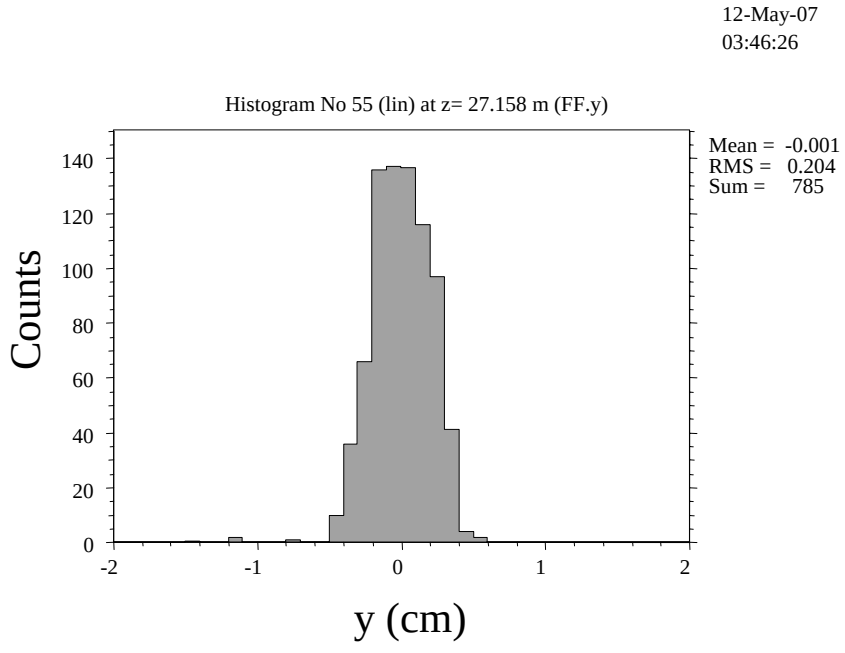










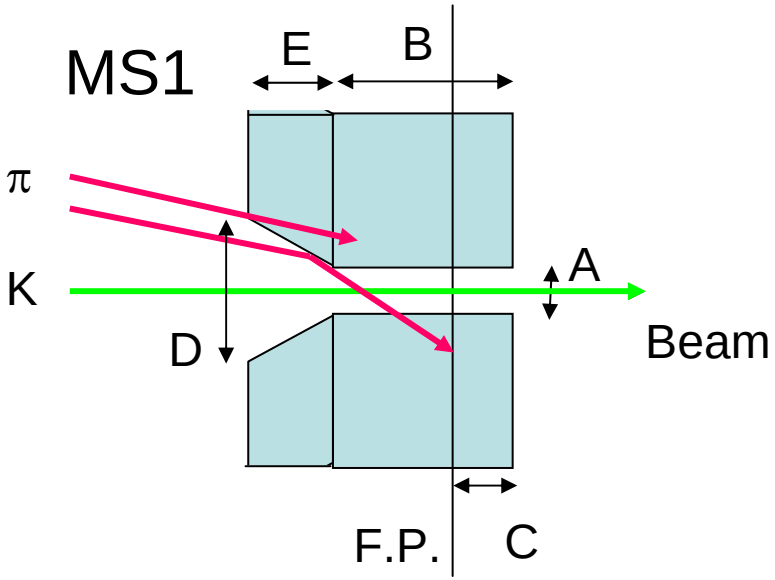


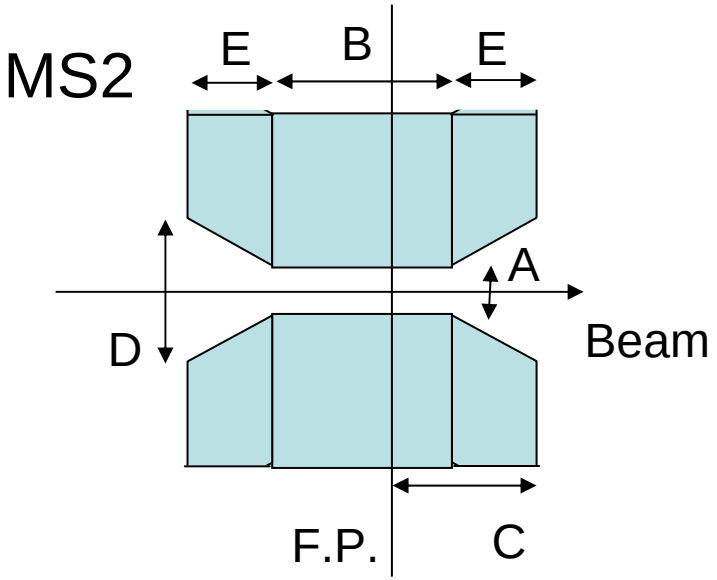
$\sigma_X \sim 3.6$ mm

$\sigma_Y \sim 2$ mm

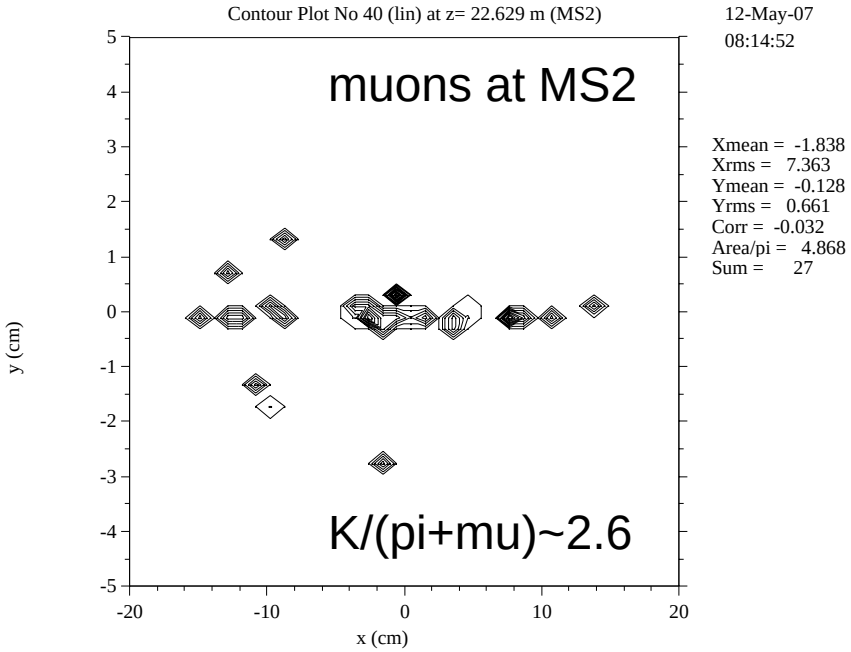
Beam Profile at FF

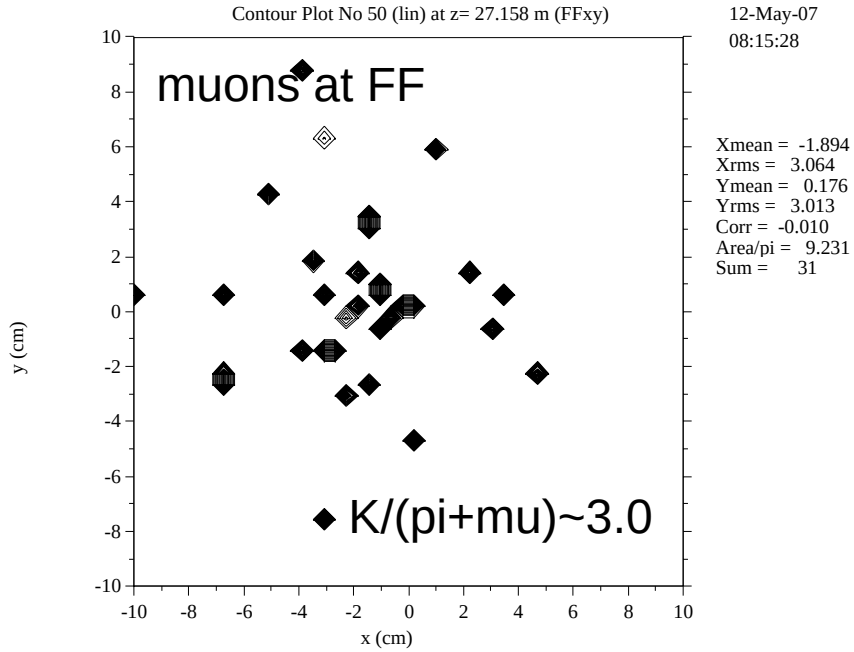
Optimization of Mass Slits (Heavy Alloy ~ 18.5g/cc)



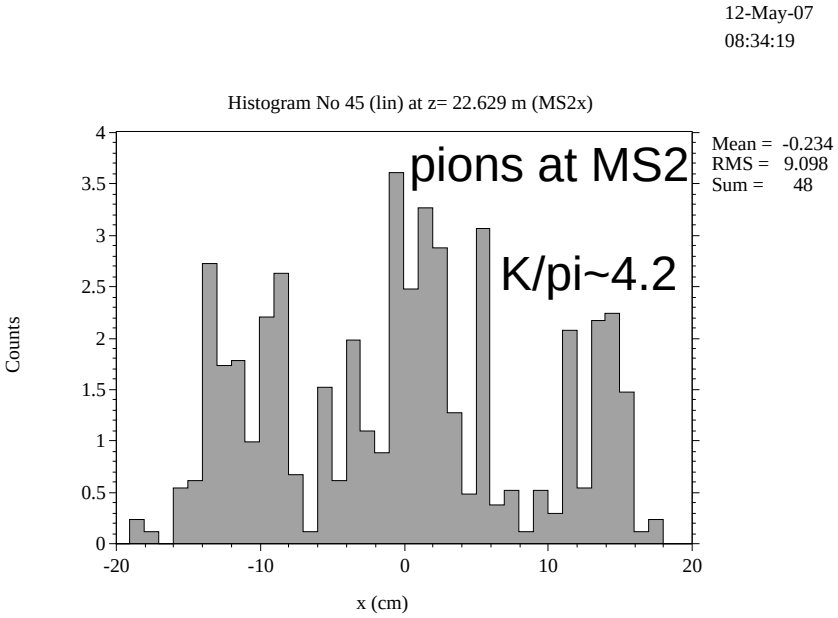


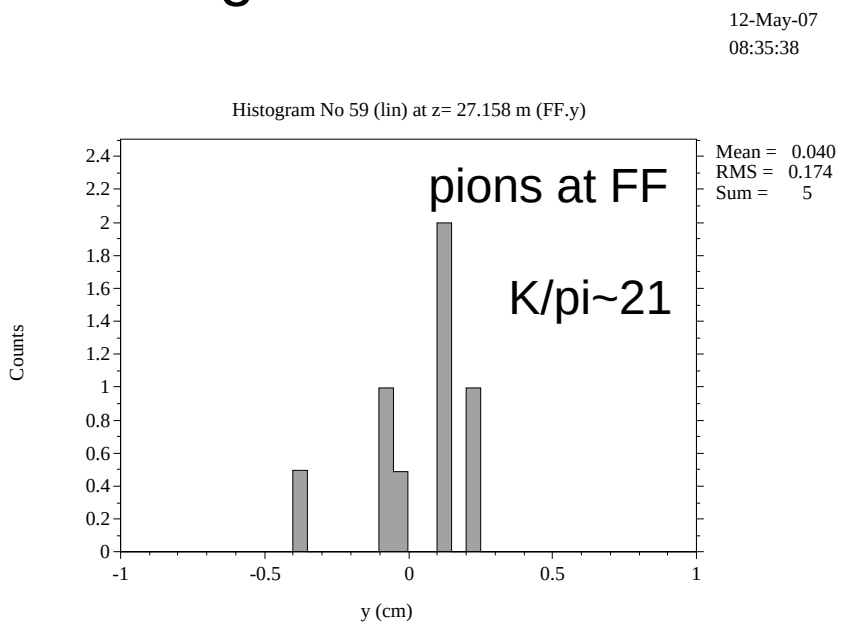
		Slit shape (mm)						Intensity (rel.)			
		A	B	C	D	E		K	pi	mu	K/all
(1)	MS1	2	250	200	5	150	MS2	732	176	108	2.6
BHK	MS2	4	300	321	5	50	FF	429	20	124	3.0
(2)	MS1	4	250	200	7	150	MS2	1387	3368	540	0.35
	MS2	4	300	321	5	50	FF	783	728	324	0.74
(3)	MS1	4	250	100	7	150	MS2	1196	5180	996	0.19
	MS2	4	300	155	5	50	FF	668	500	476	0.68

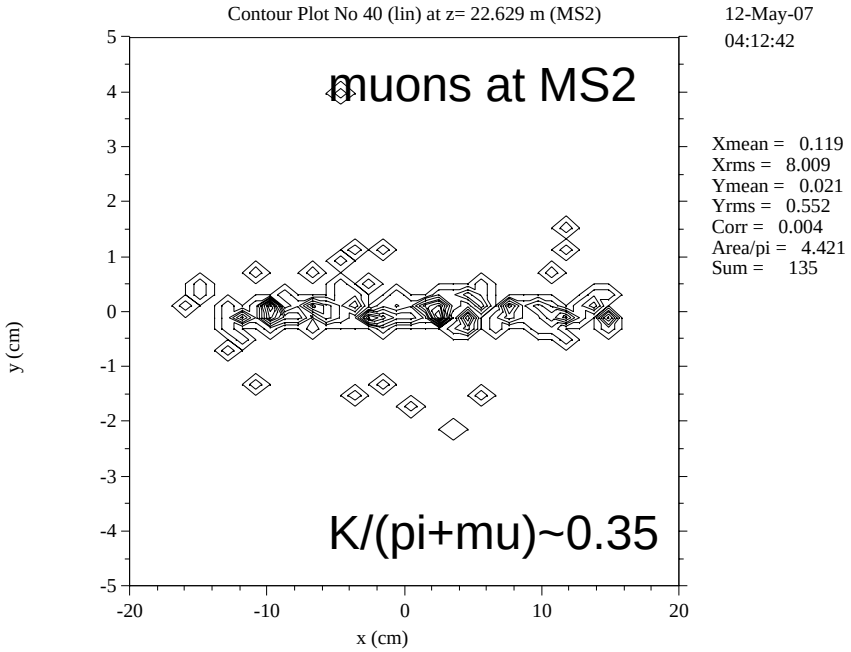


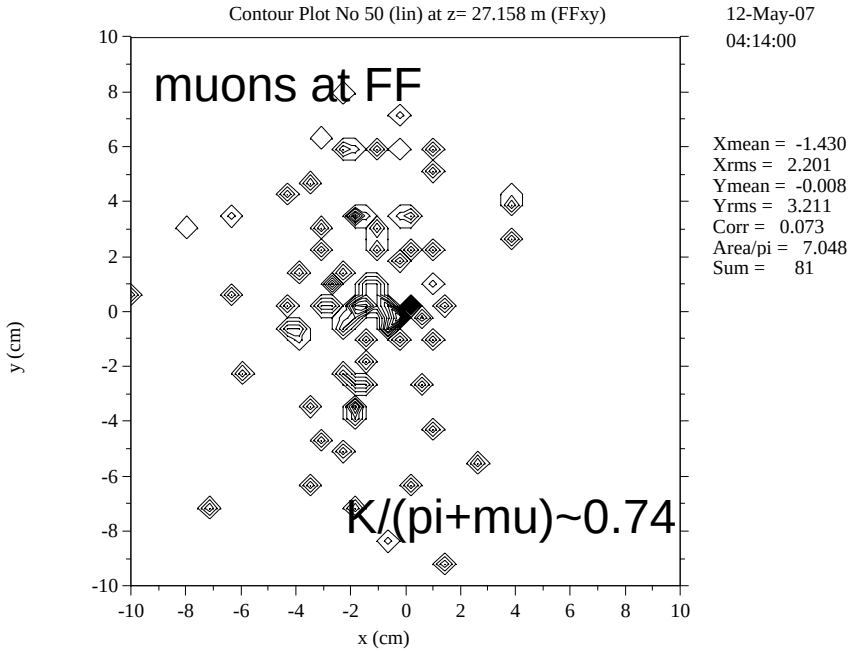


K1.1c (1) by B.H.Kang

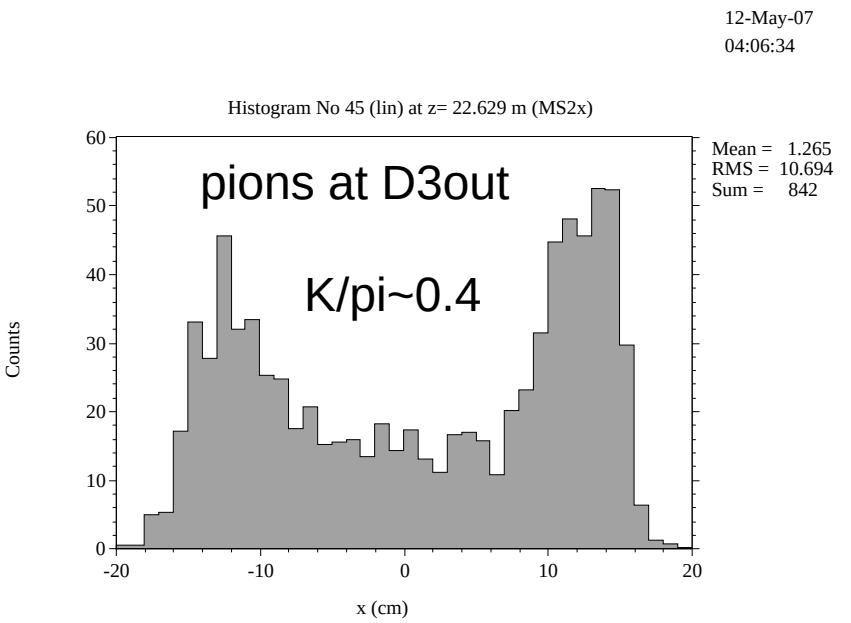


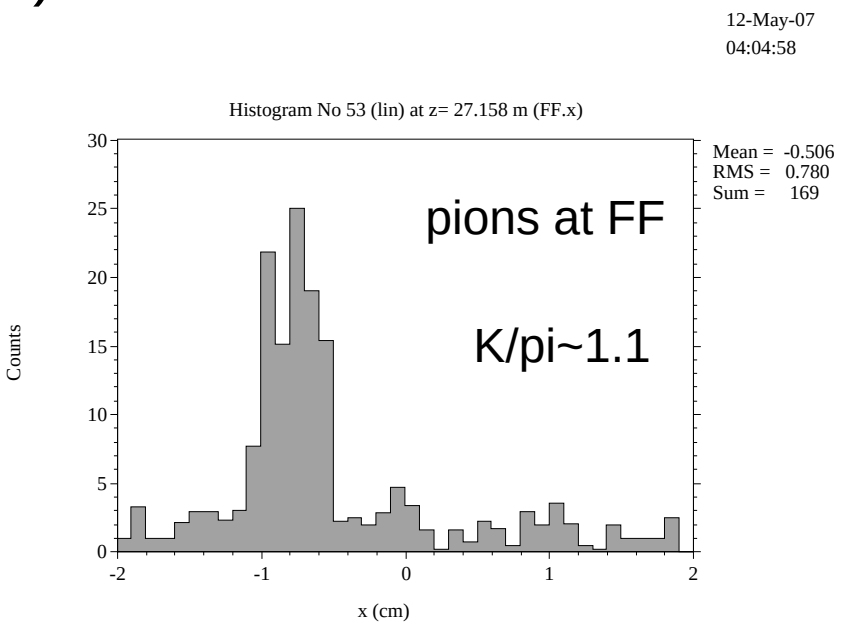


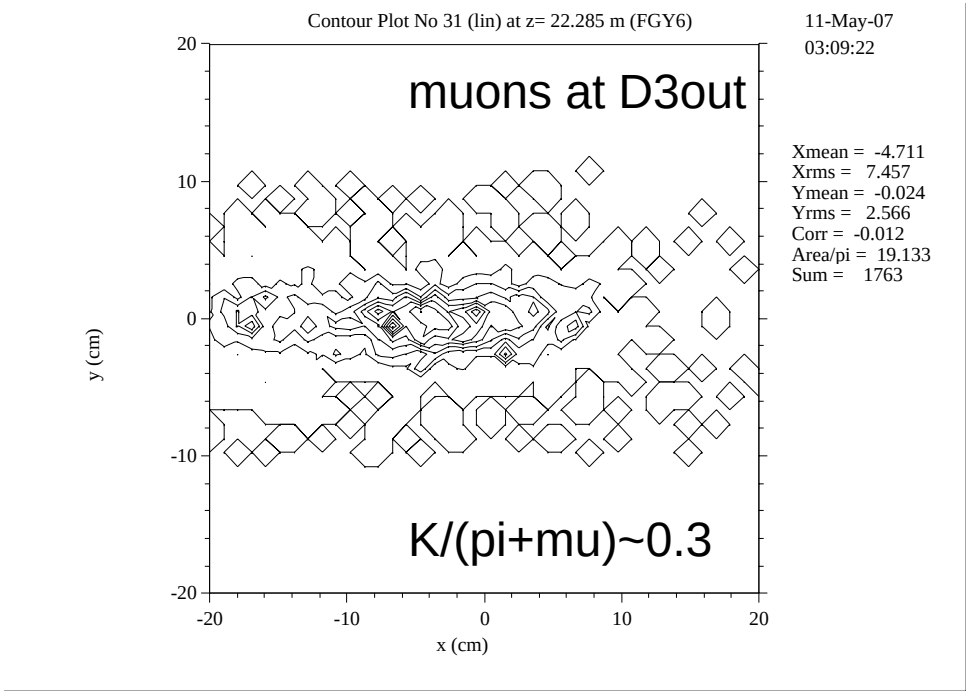

Contour Plot No 40 (lin) at z= 22.629 m (MS2)
12-May-07
04:12:42
muons at MS2
Xmean = 0.119
Xrms = 8.009
Ymean = 0.021
Yrms = 0.552
Corr = 0.004
Area/pi = 4.421
Sum = 135
K/(pi+mu)~0.35
y (cm)
x (cm)

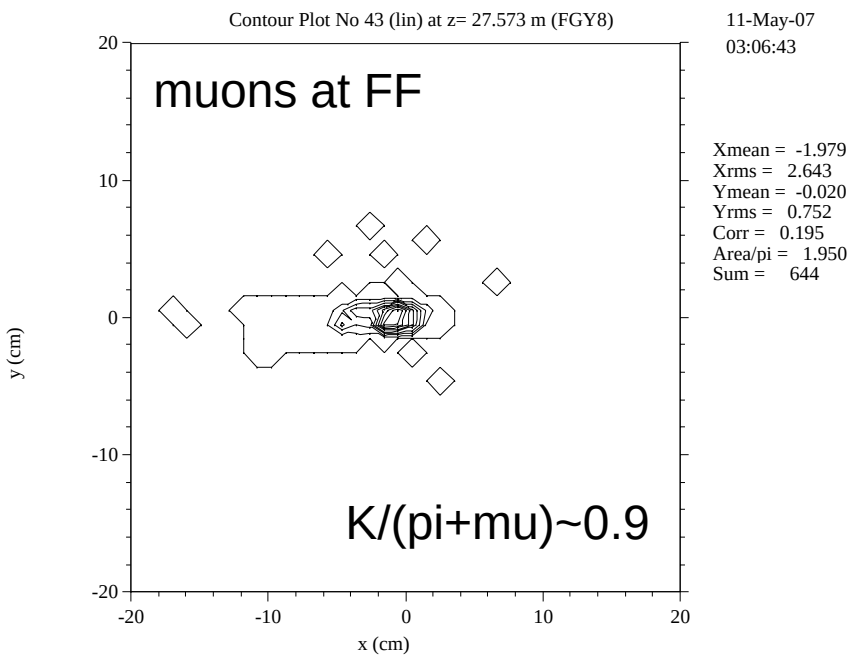

Contour Plot No 50 (lin) at z= 27.158 m (FFxy)
12-May-07
04:14:00
muons at FF
Xmean = -1.430
Xrms = 2.201
Ymean = -0.008
Yrms = 3.211
Corr = 0.073
Area/pi = 7.048
Sum = 81
K/(pi+mu)~0.74
y (cm)
x (cm)

K1.1c (2)

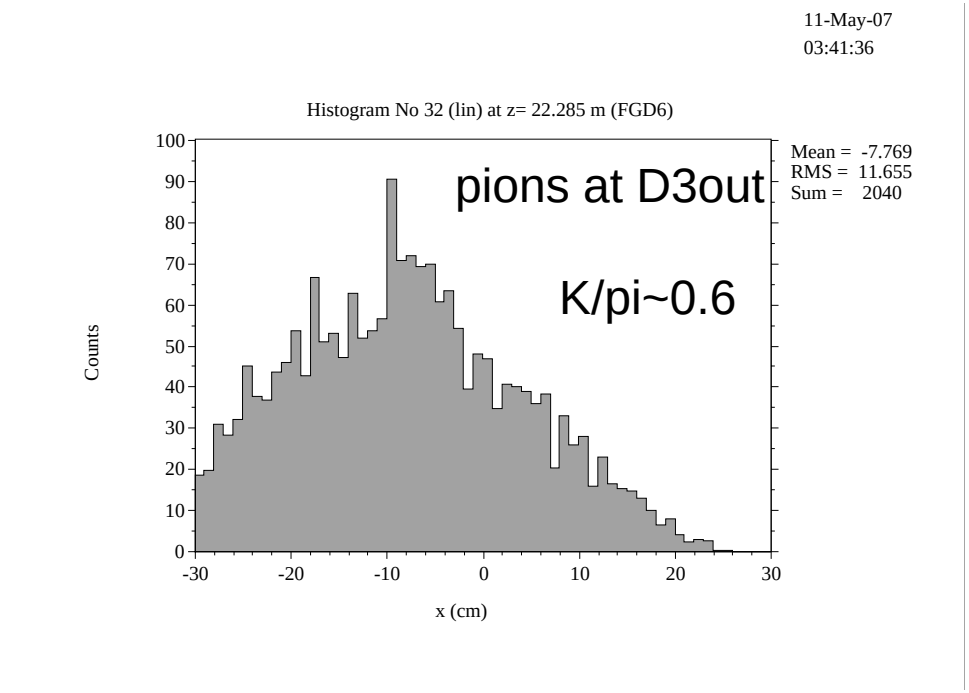

12-May-07
04:06:34
Histogram No 45 (lin) at z= 22.629 m (MS2x)
pions at D3out
Mean = 1.265
RMS = 10.694
Sum = 842
K/pi~0.4
Counts
x (cm)

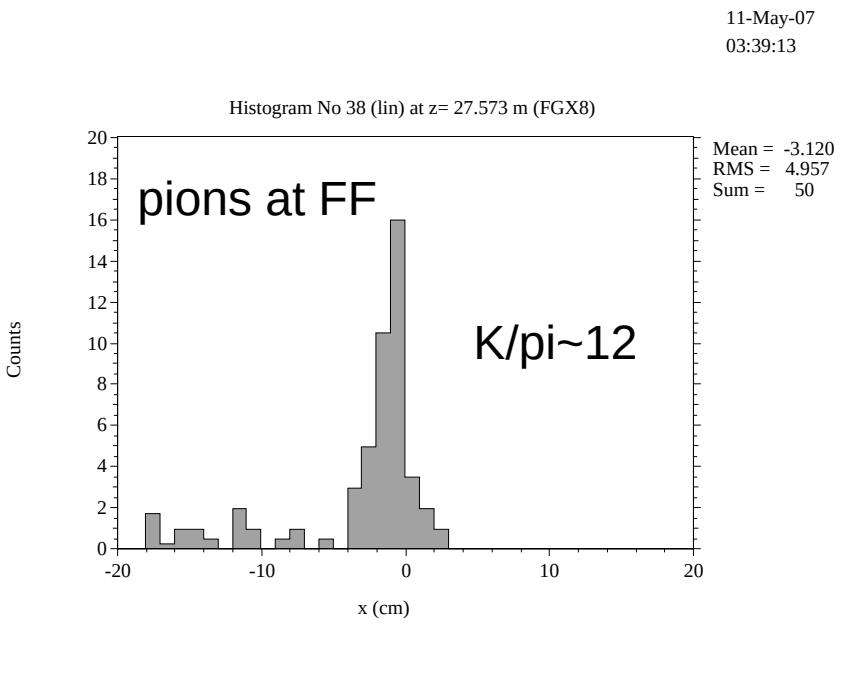

12-May-07
04:04:58
Histogram No 53 (lin) at z= 27.158 m (FF.x)
pions at FF
Mean = -0.506
RMS = 0.780
Sum = 169
K/pi~1.1
Counts
x (cm)


Contour Plot No 31 (lin) at z= 22.285 m (FGY6)
11-May-07
03:09:22
muons at D3out
Xmean = -4.711
Xrms = 7.457
Ymean = -0.024
Yrms = 2.566
Corr = -0.012
Area/pi = 19.133
Sum = 1763
K/(pi+mu)~0.3
y (cm)
x (cm)


Contour Plot No 43 (lin) at z= 27.573 m (FGY8)
11-May-07
03:06:43
muons at FF
Xmean = -1.979
Xrms = 2.643
Ymean = -0.020
Yrms = 0.752
Corr = 0.195
Area/pi = 1.950
Sum = 644
K/(pi+mu)~0.9
y (cm)
x (cm)

K1.8BR


11-May-07
03:41:36
Histogram No 32 (lin) at z= 22.285 m (FGD6)
pions at D3out
Mean = -7.769
RMS = 11.655
Sum = 2040
K/pi~0.6
Counts
x (cm)


11-May-07
03:39:13
Histogram No 38 (lin) at z= 27.573 m (FGX8)
pions at FF
Mean = -3.120
RMS = 4.957
Sum = 50
K/pi~12
Counts
x (cm)

Performance Summary

2007.5.12

For 30 GeV-9μA primary protons on the 54mm Ni Target	K1.8BR	K1.1c (BHK)	K1.1c (2)
Length (m)	27.573	27.158	27.158
Acceptance (msr.%)	2.5¥	1.2	2.1
K^- Intensity (ppp)#			
1.1 GeV/c	1.2E+06	0.6E+06	1.1E+06
0.8 GeV/c	0.2E+06		
0.6 GeV/c	0.02E+06		
Electro-static Separator	500kV/10cm 6m	750kV/10cm 2mx2	750kV/10cm 2mx2
Signles Rate @D3out(MS2) @1.1 GeV/c$	>7.7E+06	>1.4E+06	>7.4E+06
$K^-/(\pi^-+\mu^-)$ @ FF@1.1 GeV/c&	0.9	3.0	0.74
X/Y(FWHM) size @ FF (mm)	5.9/2.9	8.5/4.7	

¥ IF/MS1 Heavy Alloy: IF opening 4 mm, MS1 opening 4.66 mm

using Sanford-Wang formula, assuming 1pulse=3.53s（0.7s flat top)

$ For Signles Rate Estimation for Trigger/Tracking Devices

& cloud π not included

Prospect

- ✓ Further Optical Design
- ✓ Collect D,Q,S,O-magnets
  Front-end part
- ✓ ESS: Wien Filter Type
  → Radiation Resistant
- ✓ Collimator
- ✓ Vacuum
- ✓ Shield