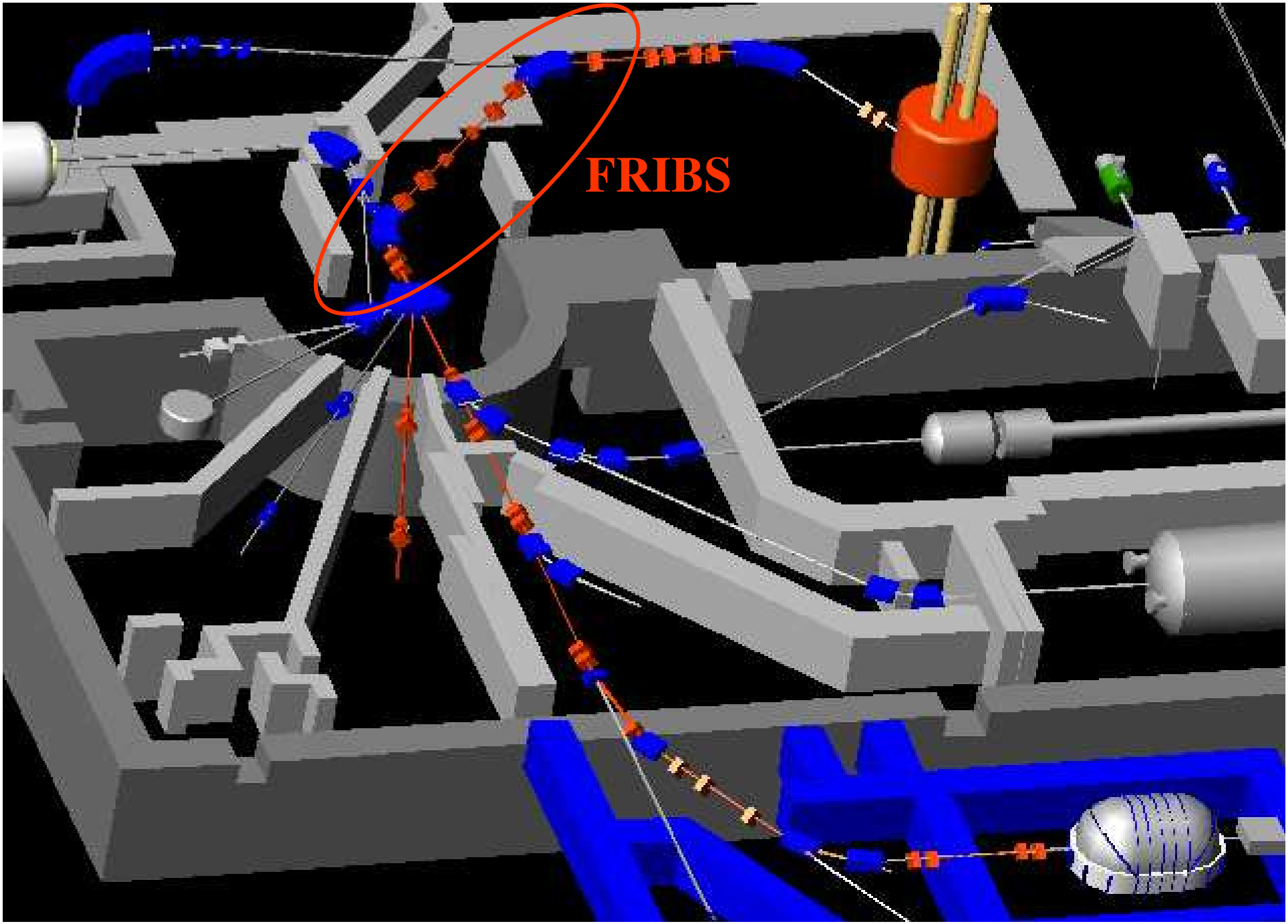
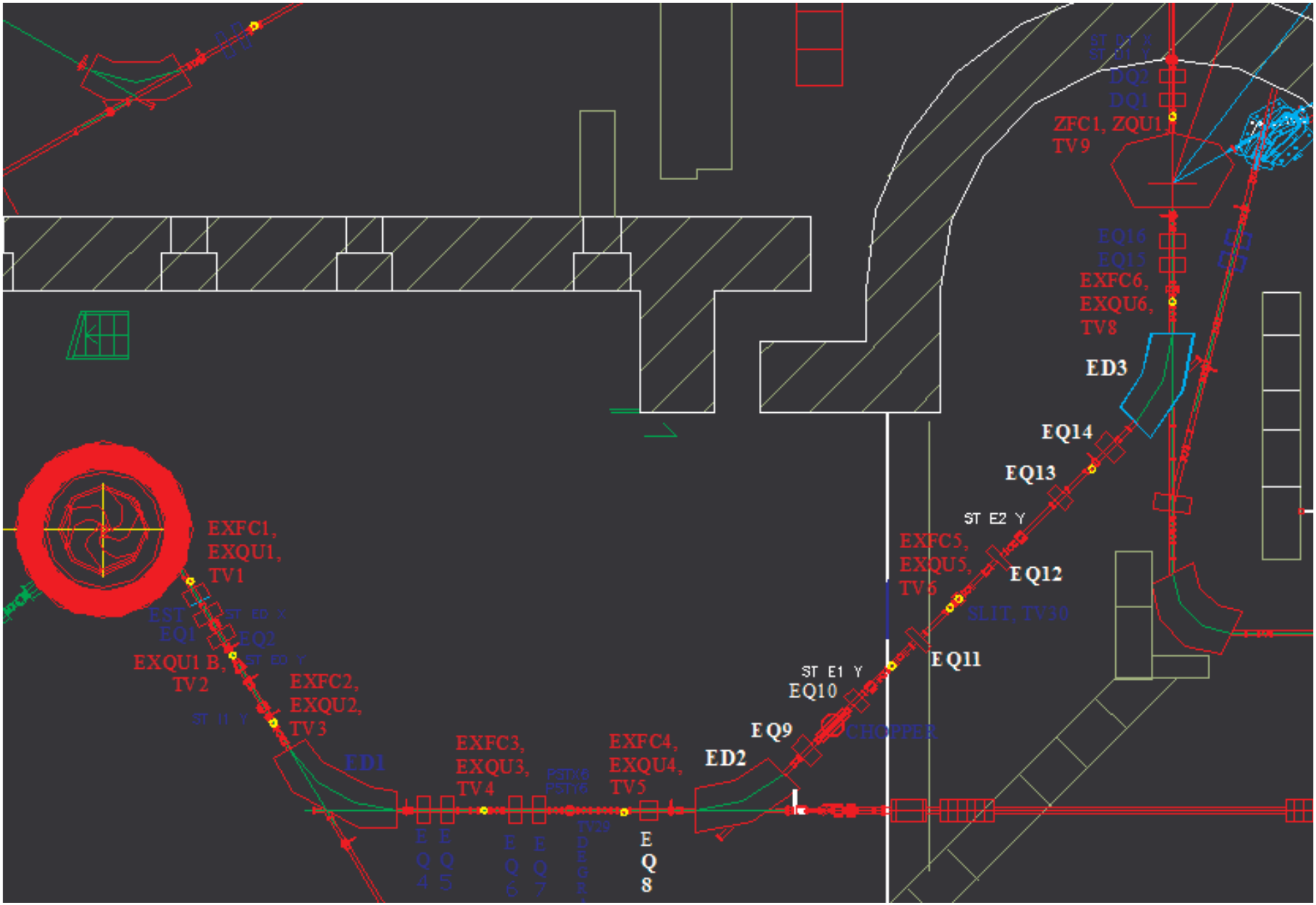
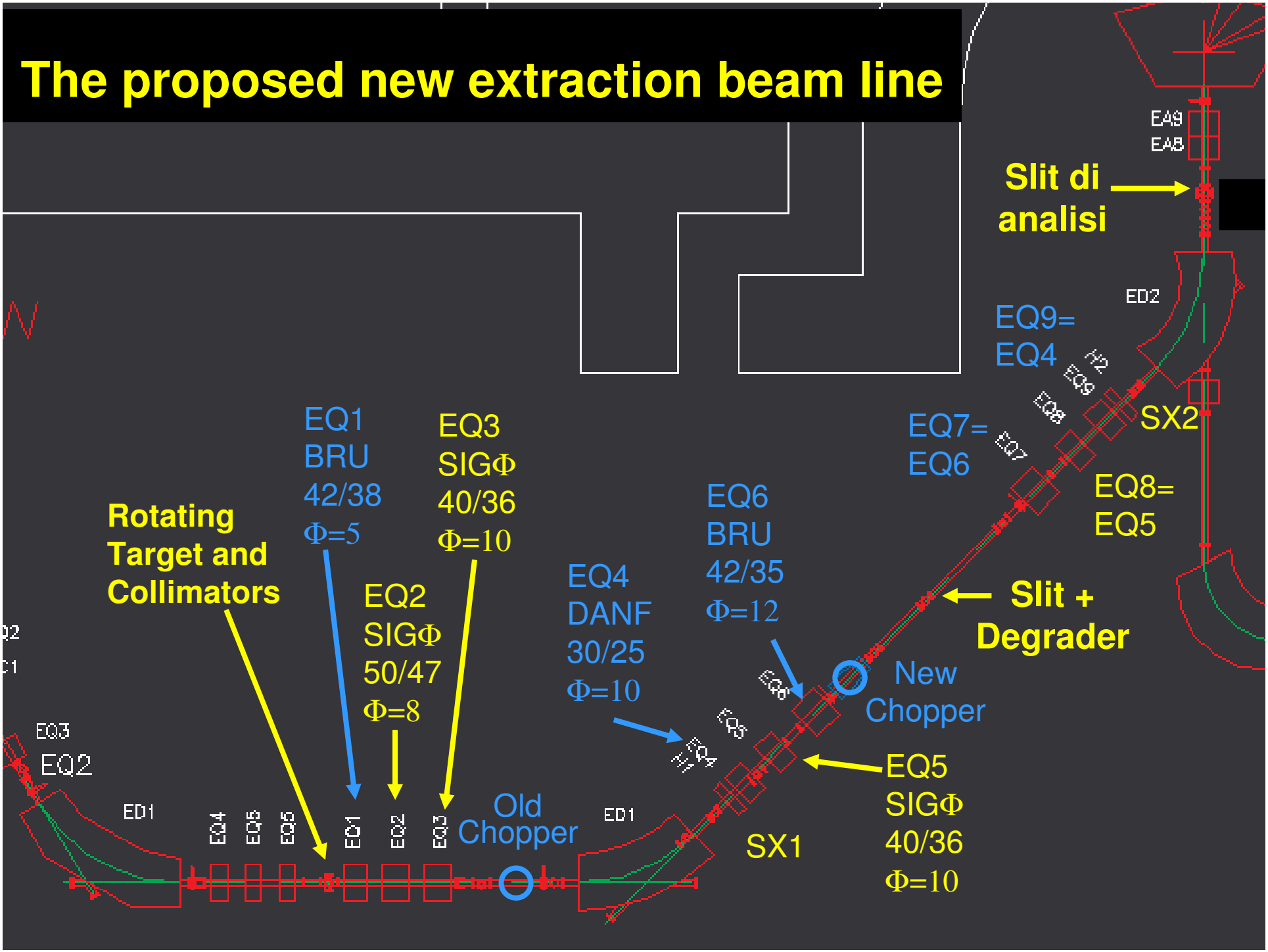

FRIBS

The extraction beam line Today



The proposed new extraction beam line

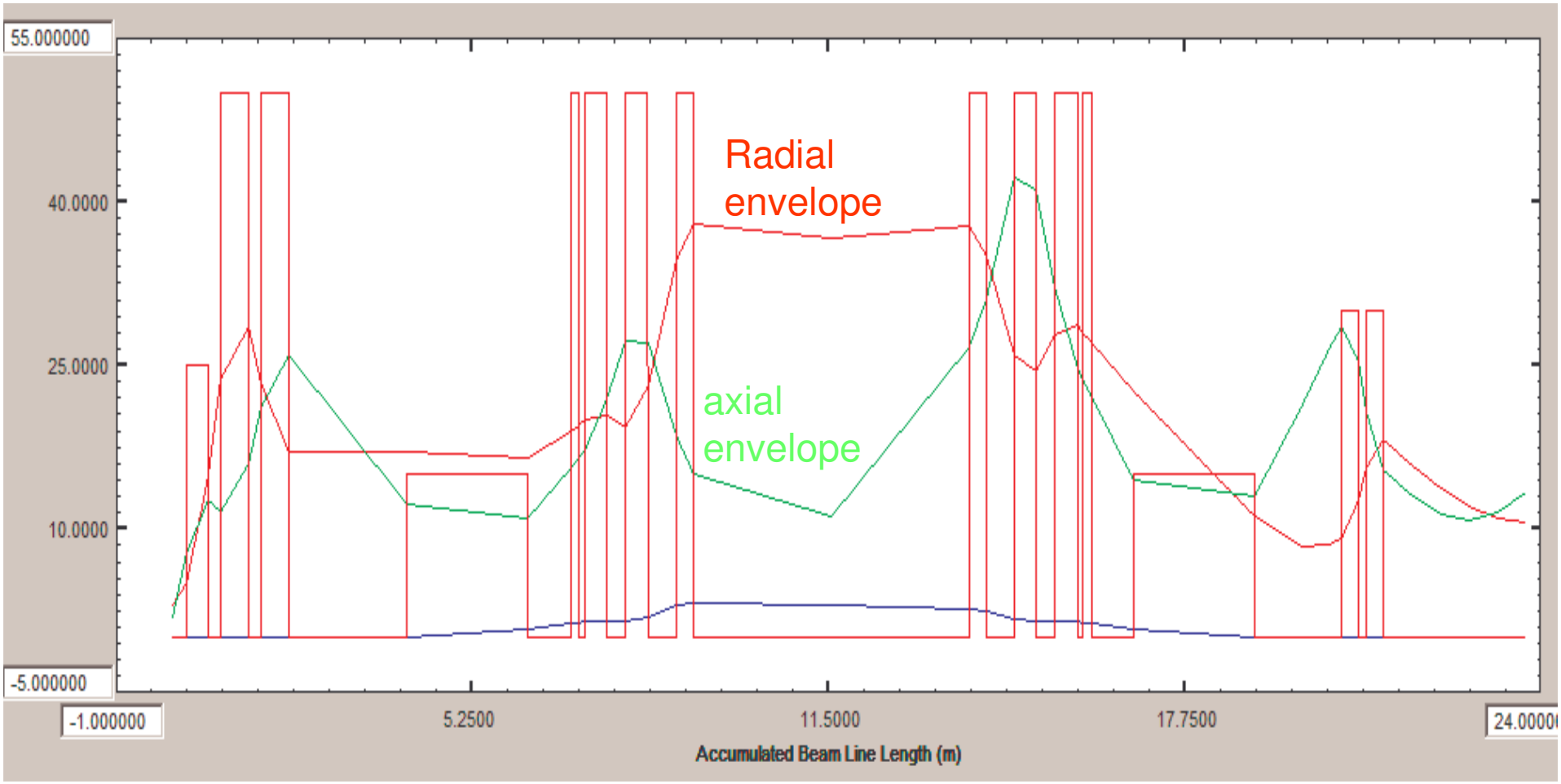


2° order beam envelope

X_i= +/-3 mm θ_i= +/- 16 mrad (+/- 1°)

Y_i= +/-2 mm ϕ_i= +/- 30 mrad (+/- 2°)

$\Delta P/P$= +/- 1%



Present Beam Line

2° order beam envelope

X_i= +/-3 mm θ_i= +/- 3 mrad

Y_i= +/-2 mm ϕ_i= +/- 7.5 mrad

$\Delta P/P$= +/- 0.5%

New Beam Line

2° order beam envelope

X_i= +/-3 mm θ_i= +/- 16 mrad (+/- 1°)

Y_i= +/-2 mm ϕ_i= +/- 30 mrad (+/- 2°)

$\Delta P/P$= +/- 1%

Expected acceptance increase

5x4x2 40 times

2° order beam envelope

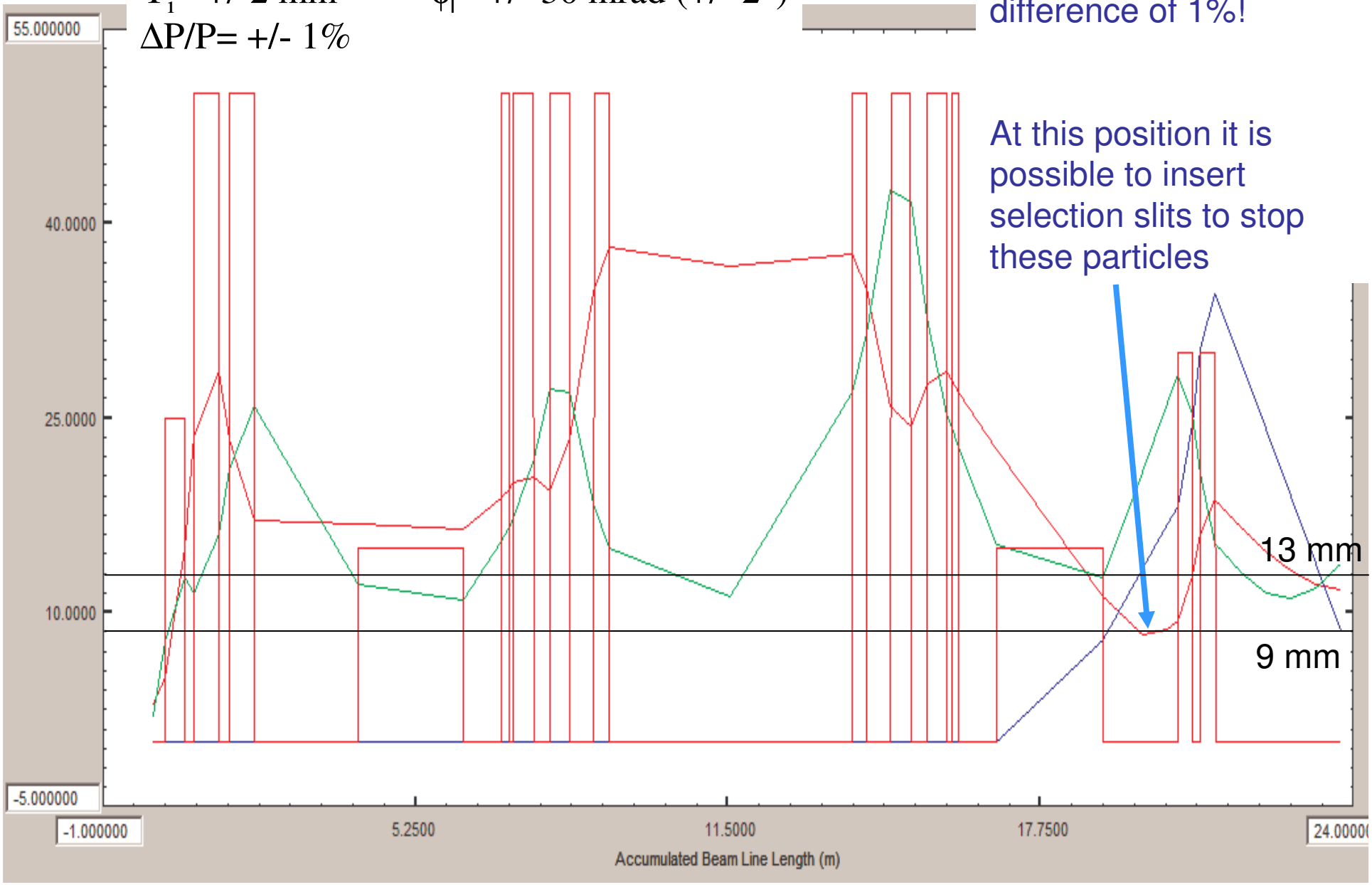
X_i= +/-3 mm θ_i= +/- 16 mrad (+/- 1°)

Y_i= +/-2 mm ϕ_i= +/- 30 mrad (+/- 2°)

$\Delta P/P$= +/- 1%

The blue line shows the position shift for particles with a momentum difference of 1%!

At this position it is possible to insert selection slits to stop these particles



2° order beam envelope

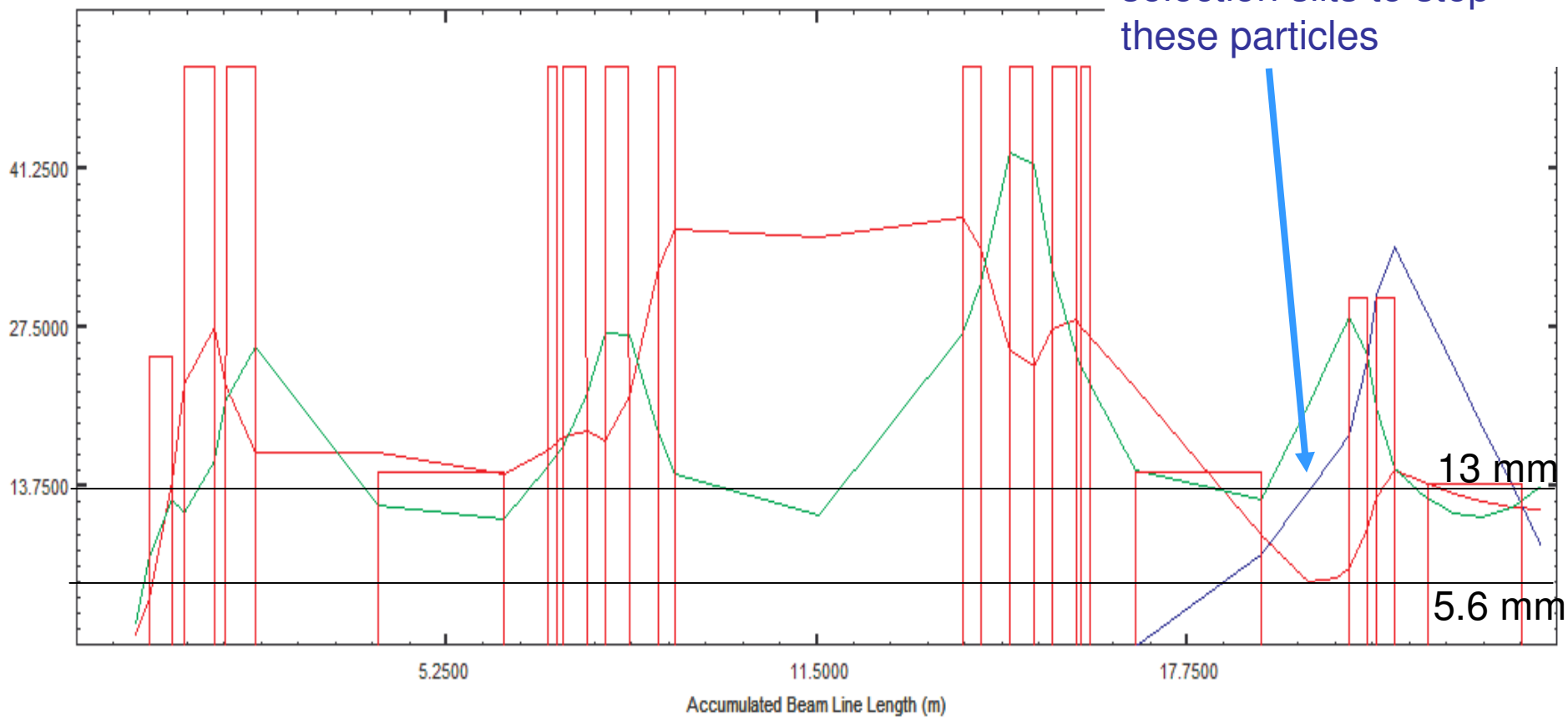
X_i= +/-1 mm θ_i= +/- 16 mrad (+/- 1°)

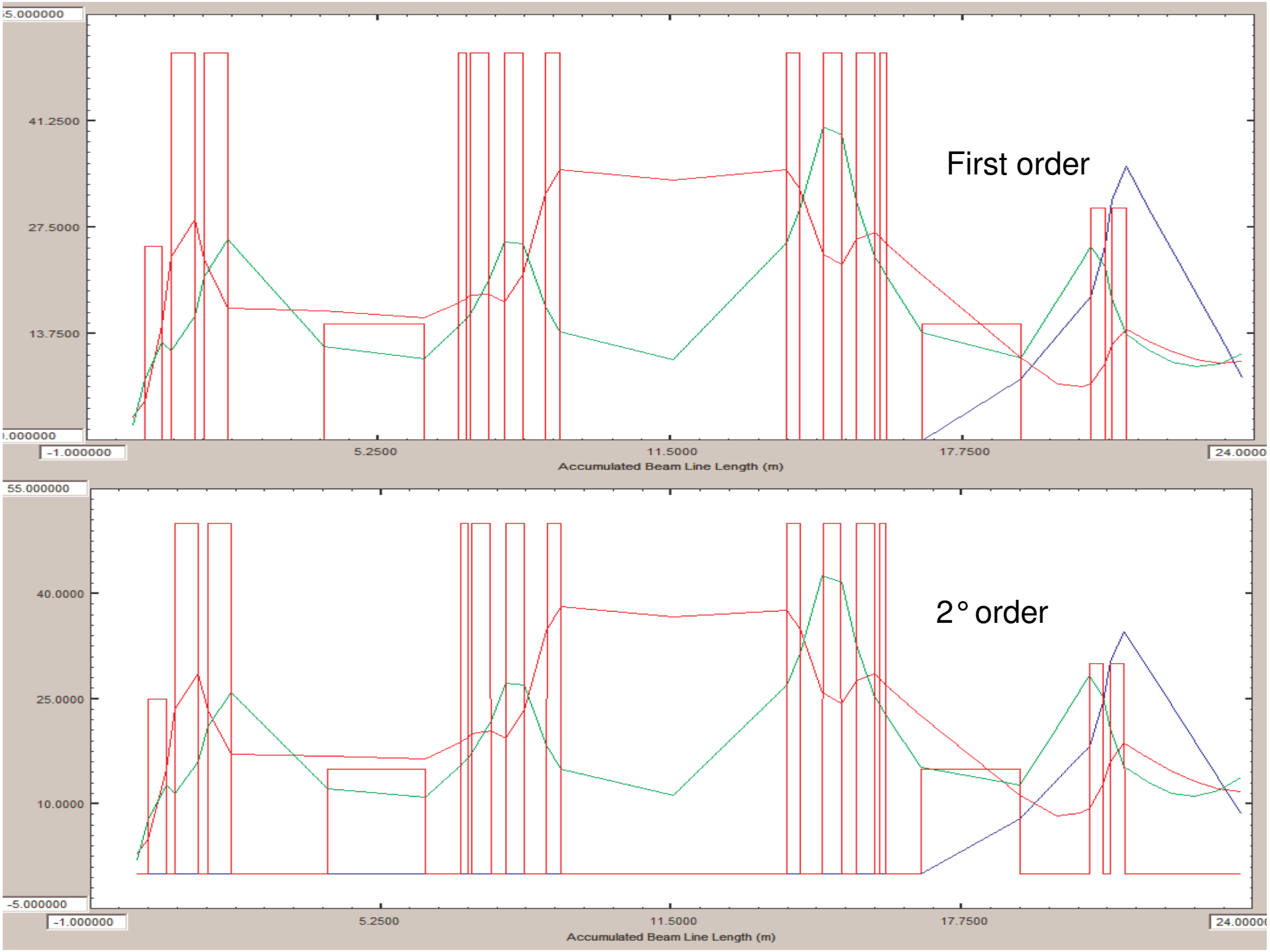
Y_i= +/-2 mm ϕ_i= +/- 30 mrad (+/- 2°)

$\Delta P/P$= +/- 1%

The blue line shows the position shift for a particle with a momentuum difference of 1%!

At this position it is possible to insert selection slits to stop these particles




5.000000
41.2500
27.5000
13.7500
.000000
First order
-1.000000
5.2500
11.5000
17.7500
24.0000
Accumulated Beam Line Length (m)
55.000000
40.0000
25.0000
10.0000
-5.000000
2° order
-1.000000
5.2500
11.5000
17.7500
24.0000
Accumulated Beam Line Length (m)

Acceptance in the transverse space and in momentum for the existing and future FRIBs line

	Acceptance (x,x') [mm.mrad]	Acceptance (y,y') [mm.mrad]	Momentum Acceptance ΔP/P
Existing line	3x3= 9π	2 x 7.5=15 π	0.5 %
New FRIBs line	**3x16=48 π**	**2x30=60 π**	1 %
Increasing factor	**5**	**4**	**2**

total 40!

Acceptance in the transverse space for the transport lines to the old and new experimental rooms

Old beam lines Medea, Ciclope, 0°	3x3= 9π	3 x 3=9 π	0.5 %	60% 40%
New beam lines Chimera, Magnex	10x4= 40 π	5 x 4=20 π	0.8 %	**Gain 9.5**
FRIBs+20° line	3x10=30 π	2x20=40 π	0.7 %	**12**

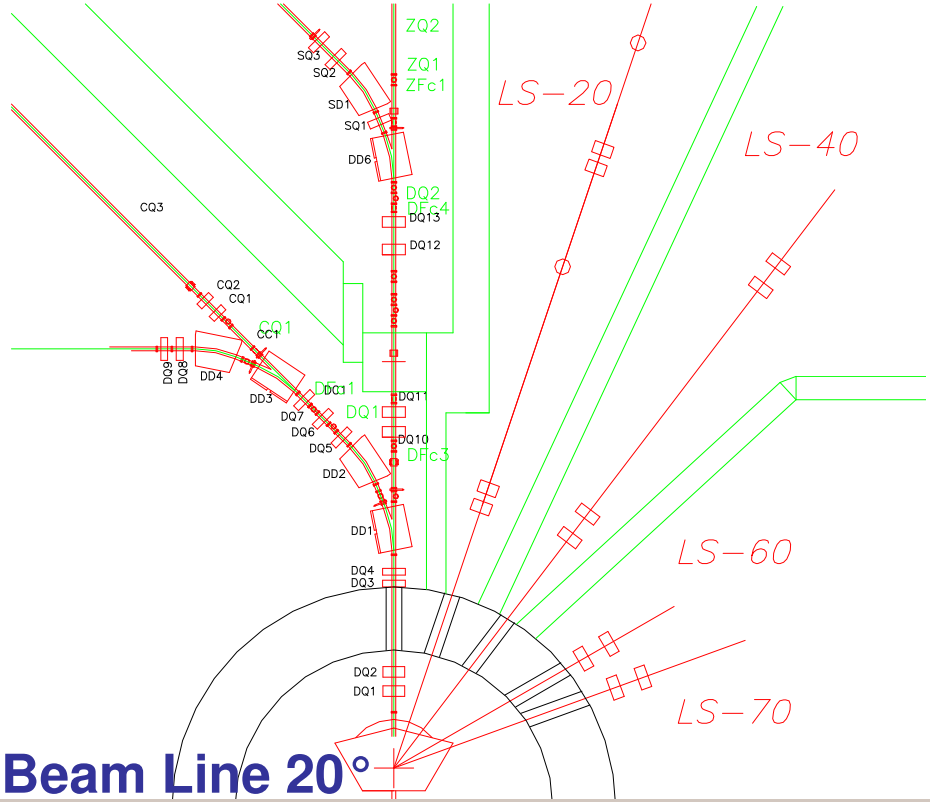
Acceptance in the transverse space and in momentum for the existing and future FRIBs line

	Acceptance (x,x') [mm.mrad]	Acceptance (y,y') [mm.mrad]	Momentum Acceptance ΔP/P
Existing line	3x3= 9π	2 x 7.5=15 π	0.5 %
New FRIBs line	**1x16=16 π**	**1x30=30 π**	1 %
Increasing factor	**5**	**4**	**2**

total 40!

Acceptance in the transverse space for the transport lines to the old and new experimental rooms. Rough evaluations!!!

New beam lines Chimera, Magnex	4.5x4= 18 π **Gain 5**	5 x 5=25 π **Gain 3.33**	0.9 % **Gain 1.8**	**Gain 30**
FRIBs+20° line	3x10=30 π **Gain 5**	2x20=40 π **Gain 4**	0.7 % **Gain 1.4**	**28**

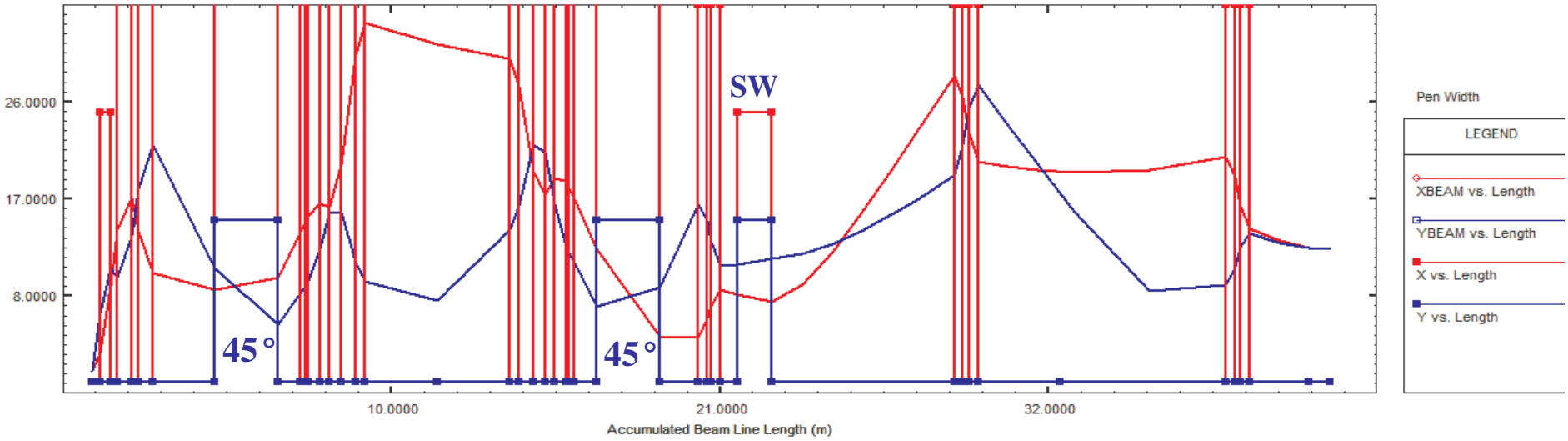


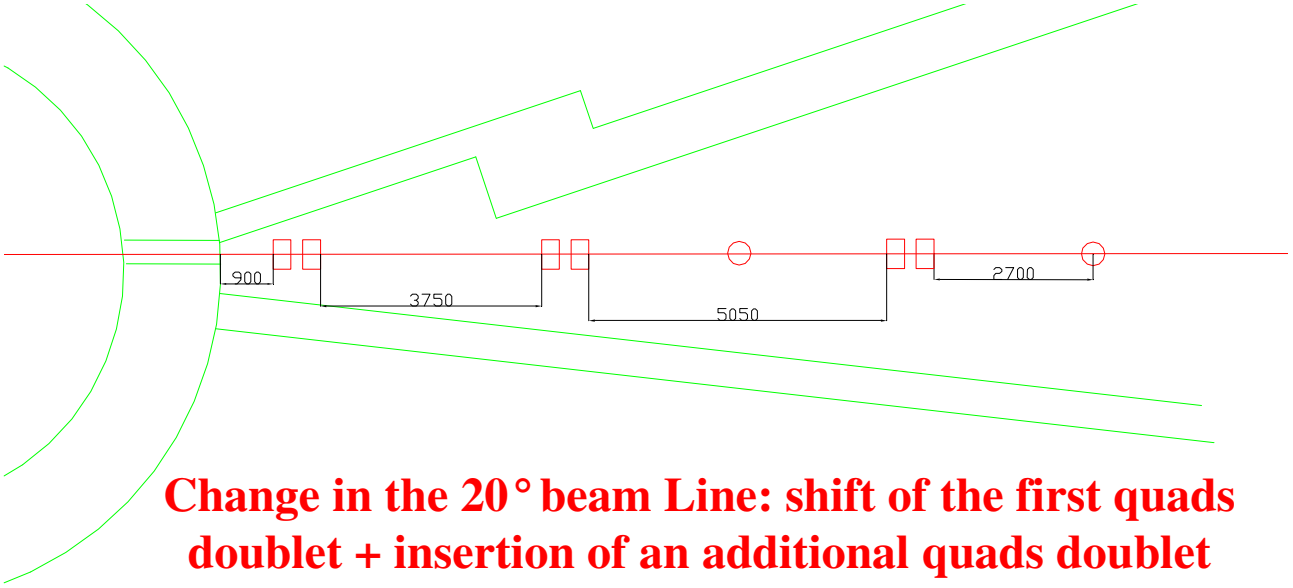
Beam Line 20°

Beam spot at production target: ϕ=2 mm, X'=±10 mrad, Y'=±25 mrad, ΔP/P=±1 %

Beam spot size at beam line end x=y = ±12.5 mm

Gain 21





Change in the 20° beam Line: shift of the first quads doublet + insertion of an additional quads doublet

Beam spot at production target: ϕ=2 mm, X'=±16 mrad, Y'=±30 mrad, ΔP/P=±1 %

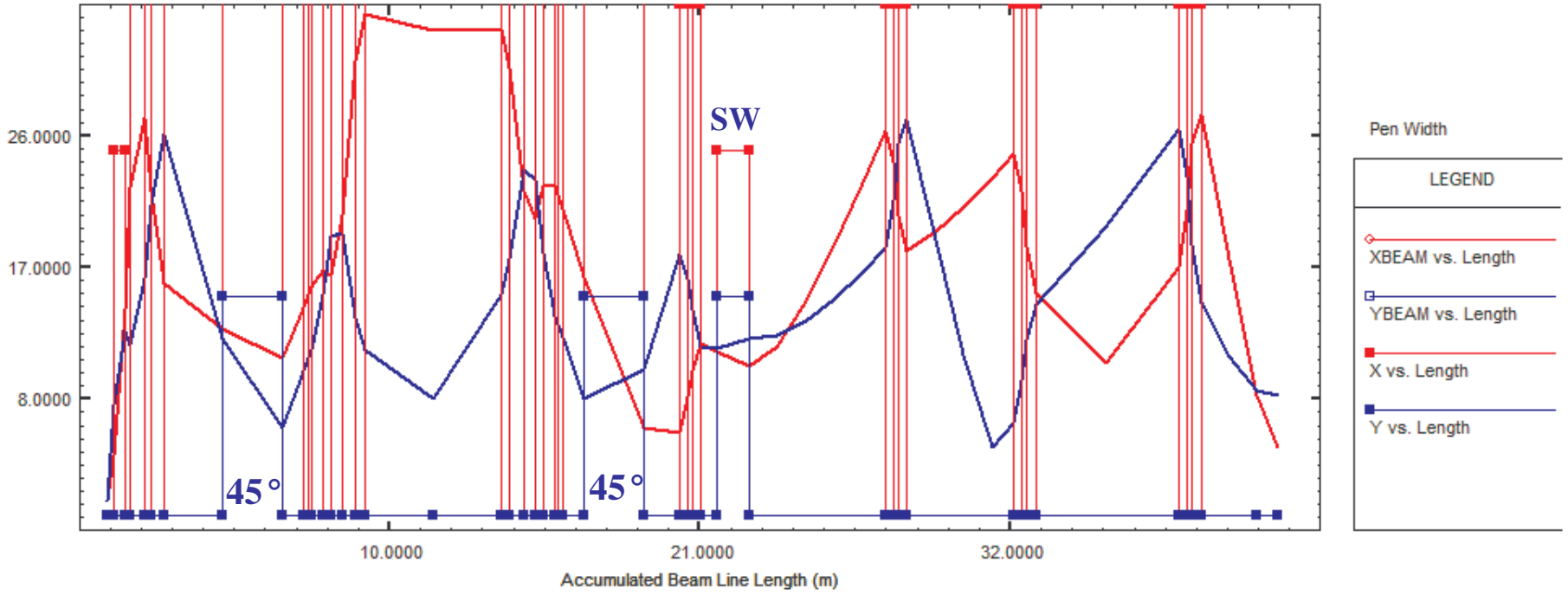
Beam spot size at beam line end

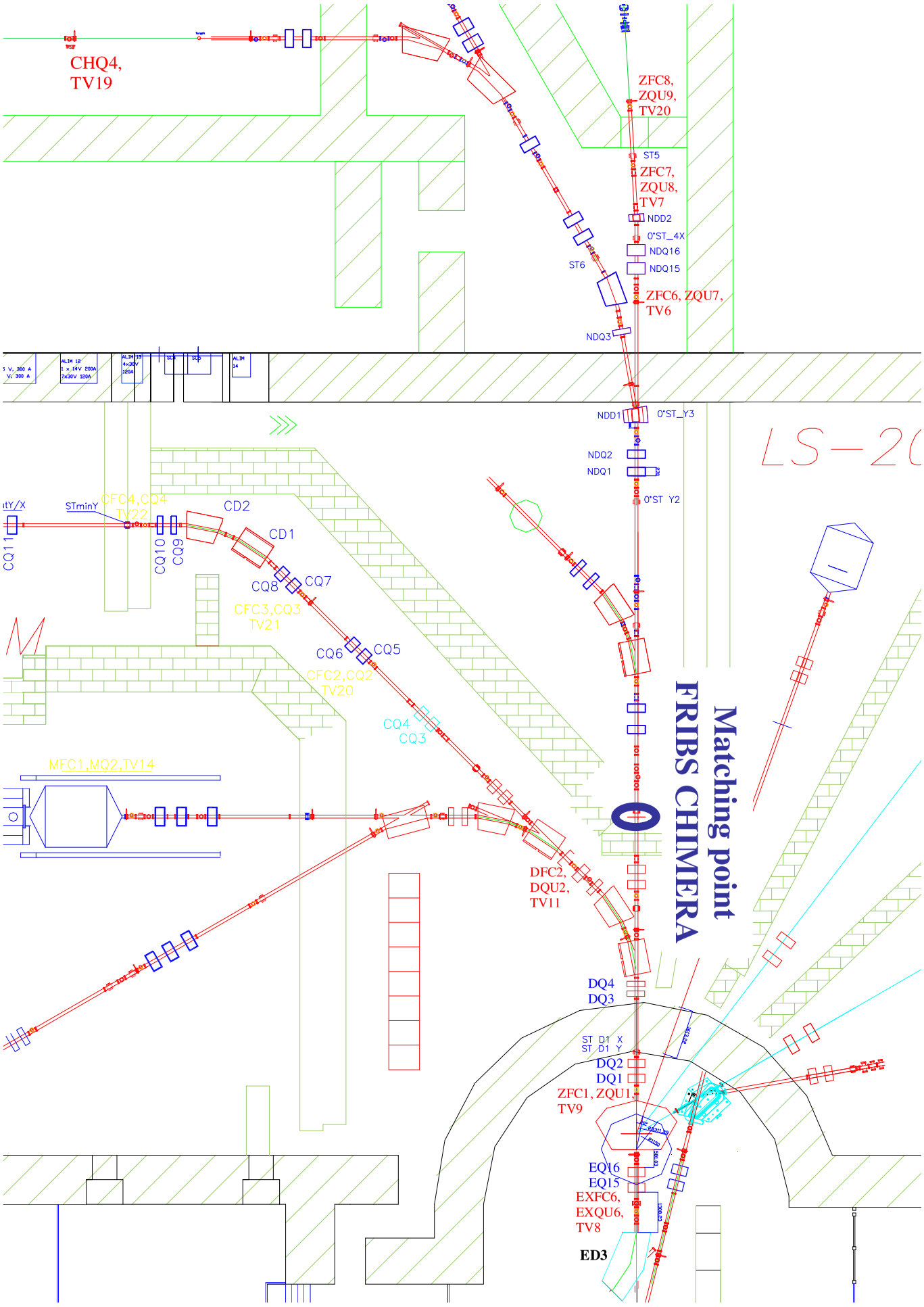
x= ± 5 mm;

y = ±8.2 mm

Gain 40

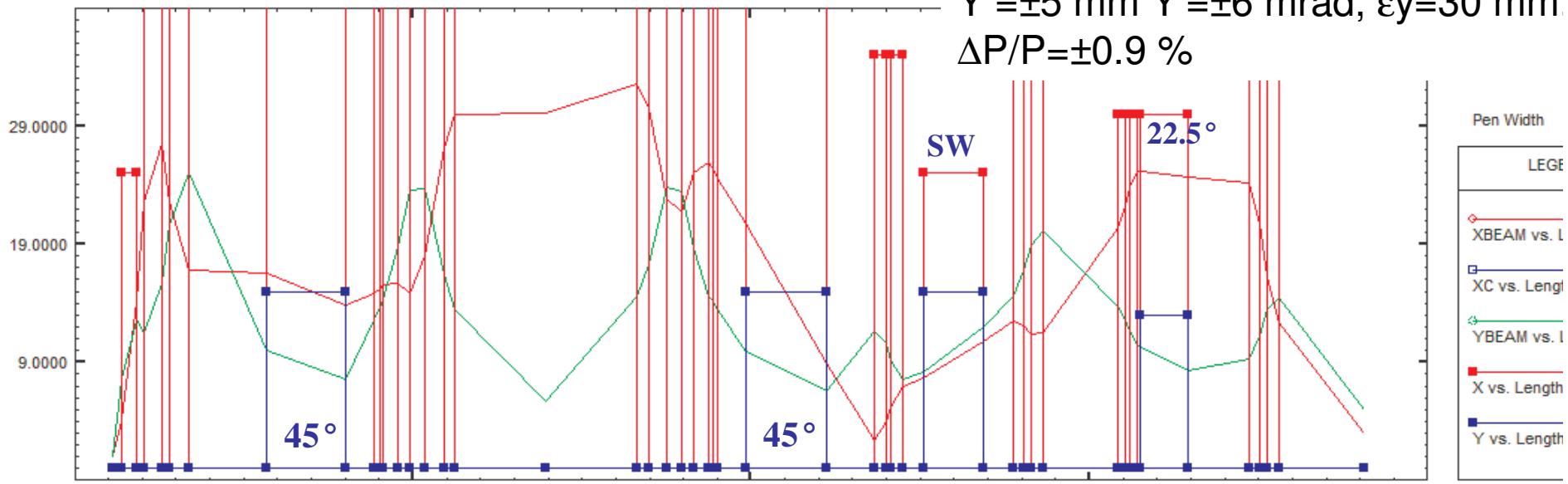
Beam Line 20°




CHQ4,
TV19
ZFC8,
ZQU9,
TV20
ST5
ZFC7,
ZQU8,
TV7
NDD2
0°ST_4X
NDQ16
NDQ15
ST6
ZFC6, ZQU7,
TV6
NDQ3
NDD1
0°ST_Y3
NDQ2
NDQ1
0°ST Y2
LS-2(
CFC4,CQ4
TV22
STminY
CD2
CD1
CQ11
CQ10
CQ9
CQ8
CQ7
CFC3,CQ3
TV21
CQ6
CQ5
CFC2,CQ2
TV20
CQ4
CQ3
MFC1,MQ2,TV14
DFC2,
DQU2,
TV11
Matching point
FRIBS CHIMERA
DQ4
DQ3
ST_D1_X
ST_D1_Y
DQ2
DQ1
ZFC1, ZQU1,
TV9
EQ16
EQ15
EXFC6,
EXQU6,
TV8
ED3

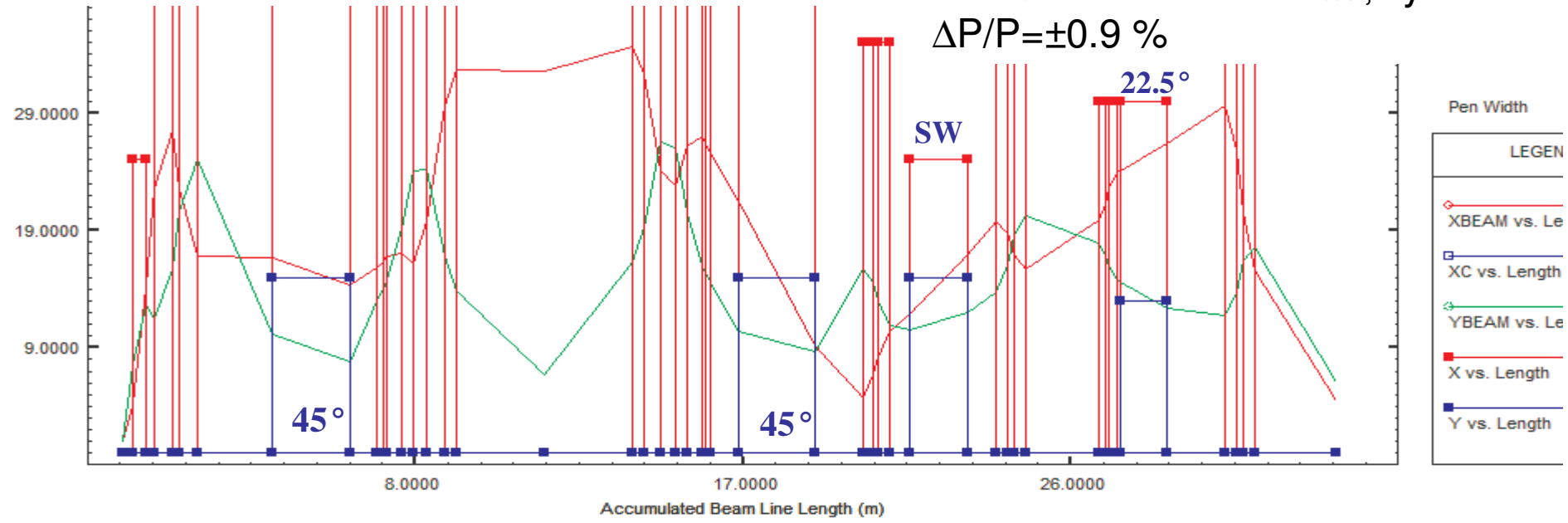
Linea FRIBS + transfer to CHIMERA, 1° order

x=±3 mm, X'=±5.3 mrad, εx=16 mr
Y =±5 mm Y'=±6 mrad, εy=30 mm
ΔP/P=±0.9 %



Linea FRIBS + transfer to CHIMERA, 2° order

x=±4.5 mm, X'=±6.6 mrad, εx=30 m
Y =±6 mm Y'=±7.1 mrad, εy=42 mm
ΔP/P=±0.9 %



CHIMERA Acceptance:

x=±3 mm, X'=±5.7 mrad, ε_x=17 mm.mrad

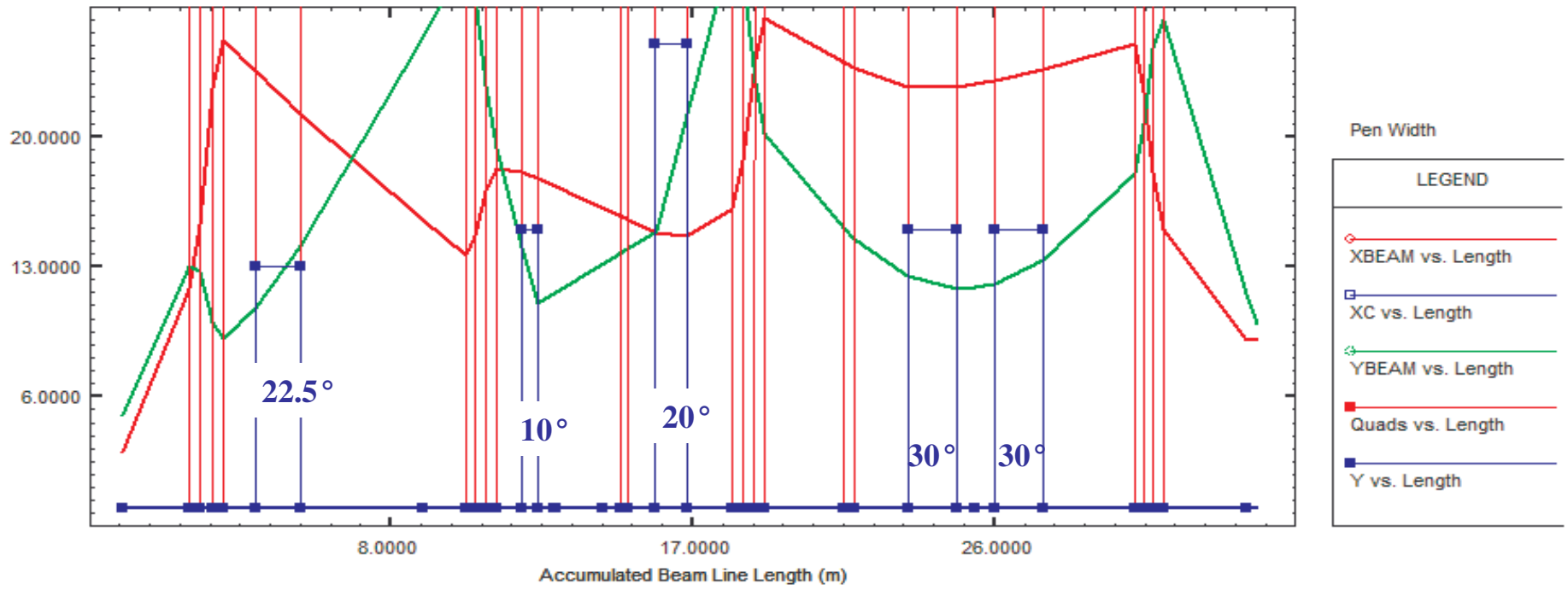
Y =±5 mm Y'=±6 mrad, ε_y=30 mm.mrad

$\Delta P/P$=±0.9 %

Beam spot size at beam line end

x= y = ±8.6 mm

Gain 36



FRIBS emittance:

x=±4.44 mm, X'=±6.7 mrad, ε_x=29.7 mm.mrad (17)

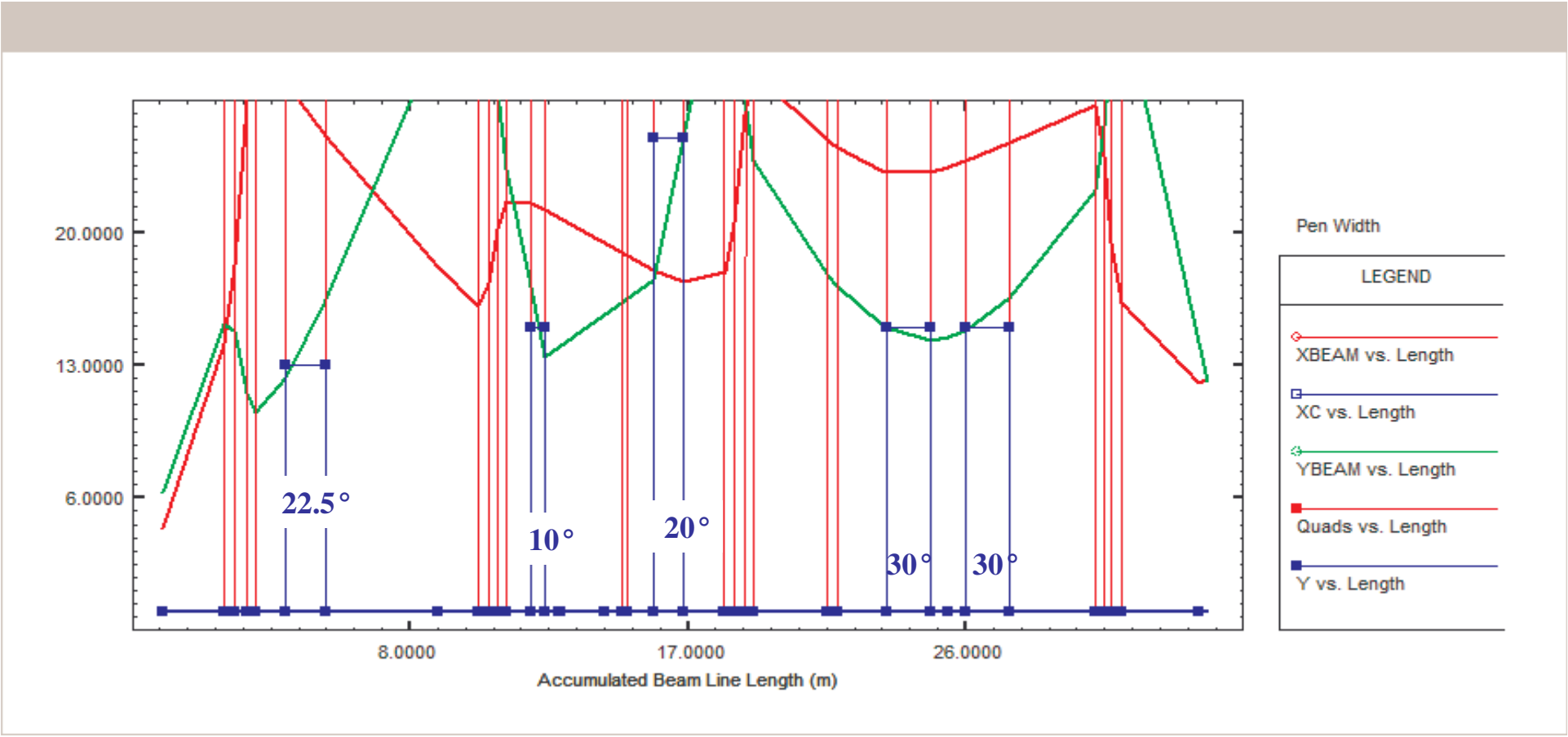
Y =±6.32 mm Y'=±6.88 mrad, ε_y=43.48 mm.mrad (30)

$\Delta P/P$=±0.9 %

Beam spot size at beam line end

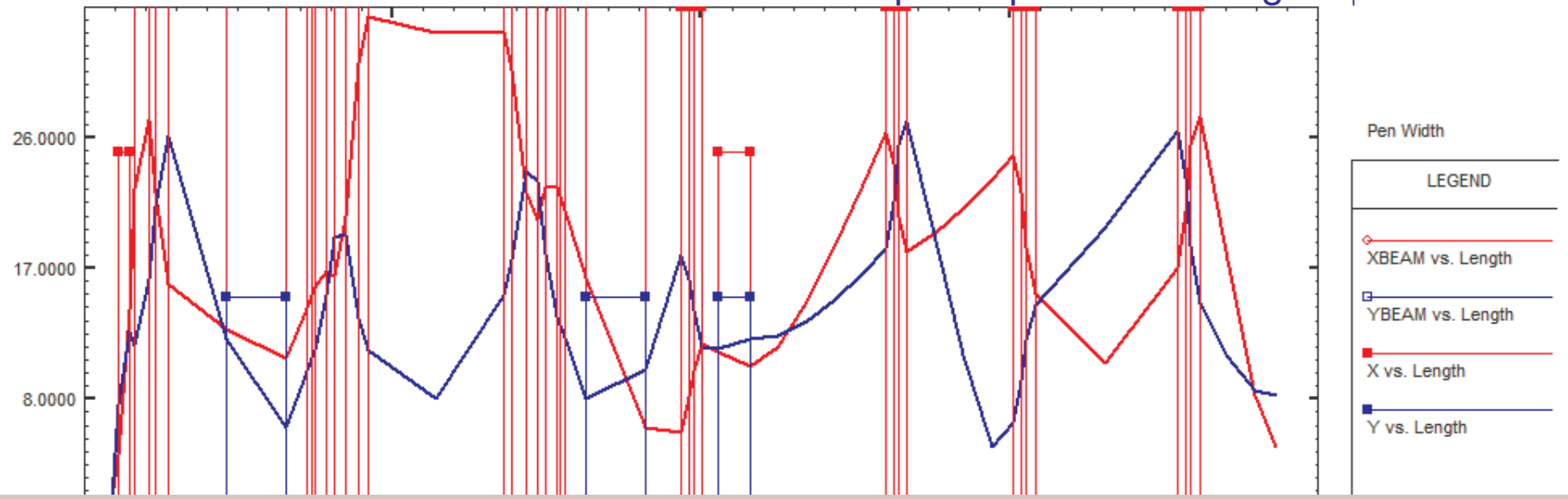
x= y = ±12.2 mm

Gain expected 14



Beam Line 20°

Beam spot at production target: ϕ=2 mm



Beam Line 20°

Beam spot at production target: ϕ=4 mm

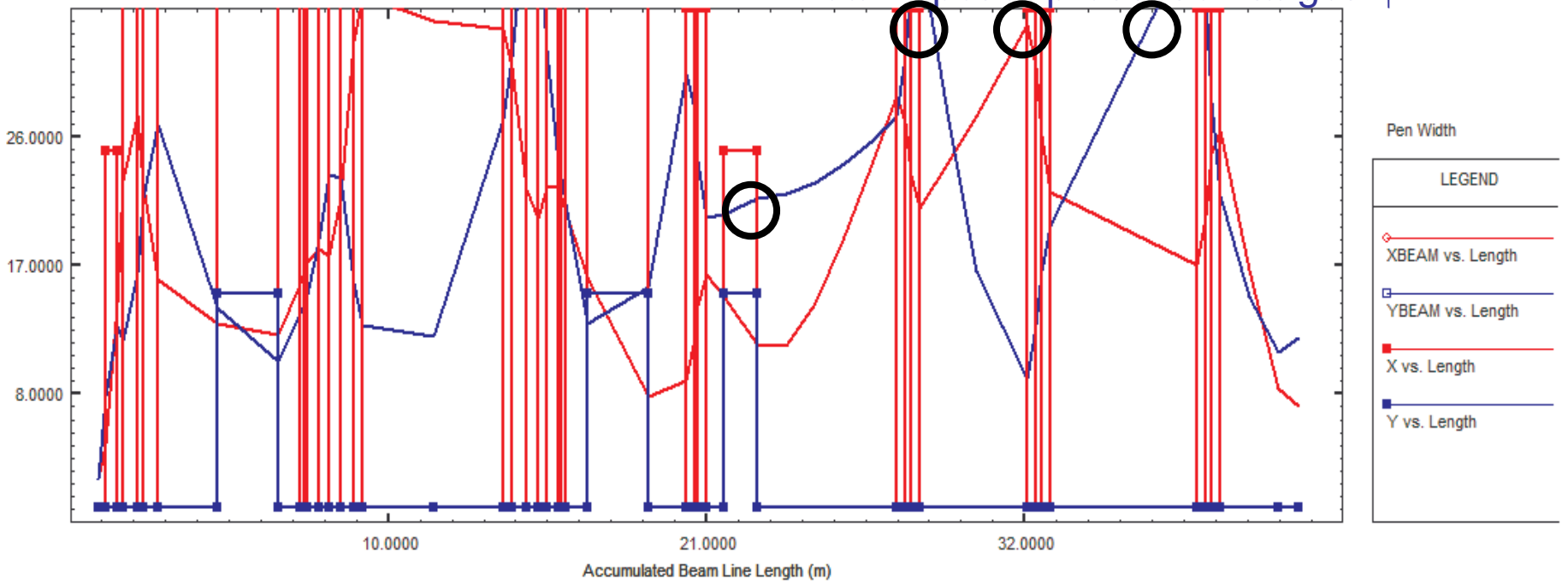


Table IX. - Central ray data and dispersions at $\Theta = 92°$

Z/A	B_o kG	R cm	P Mev/c	α deg	R_{16} cm/(%∂p/p)	R_{26} mrad/(%∂p/p)
0.5	31.3	216.60	444.2257	62.14	-2.6494	-13.5850
	22.0	216.61	289.6852	61.08	-5.4326	-29.5160
0.4	22.0	216.59	228.3954	61.05	-3.7254	-24.6100
0.3	41.4	216.59	338.5912	65.02	+6.0460	-14.6500
	22.0	216.59	168.5028	60.99	+2.7160	+7.3520
0.25	45.5	216.60	307.4121	65.58	+11.6082	+1.7000
0.1	47.5	216.59	122.6658	65.77	+8.9542	-5.5390
	25.0	216.61	62.9489	60.91	-0.6820	-16.1020

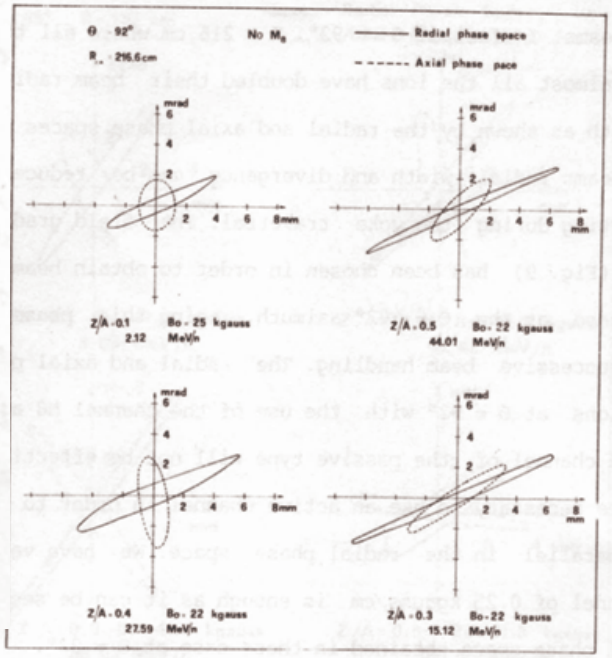
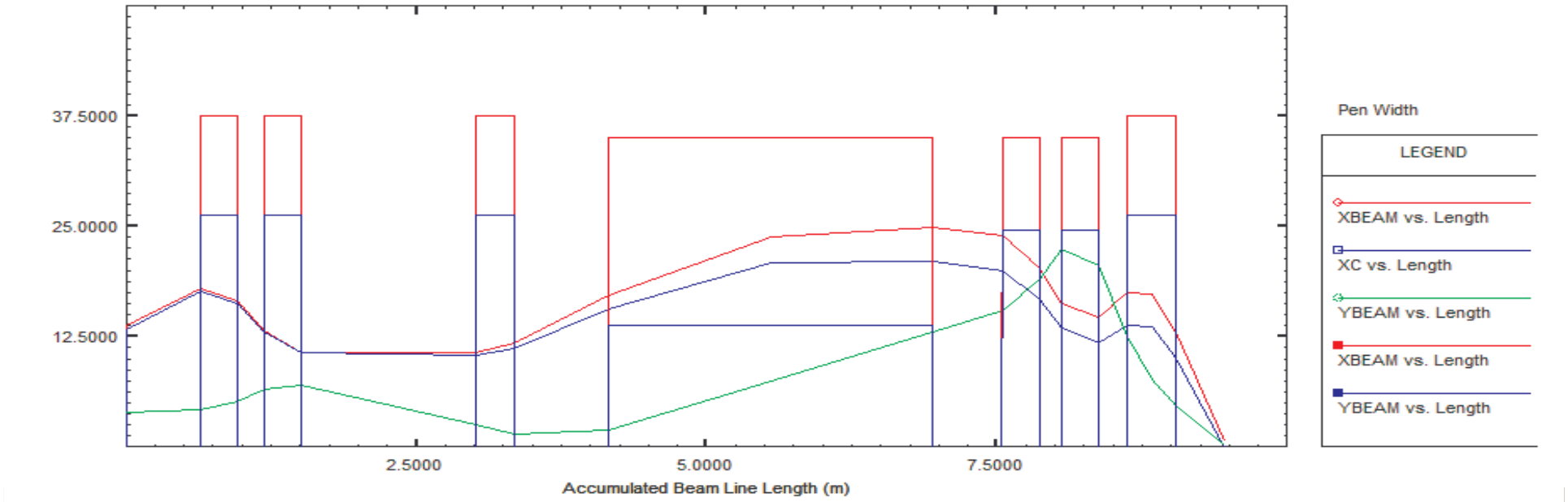
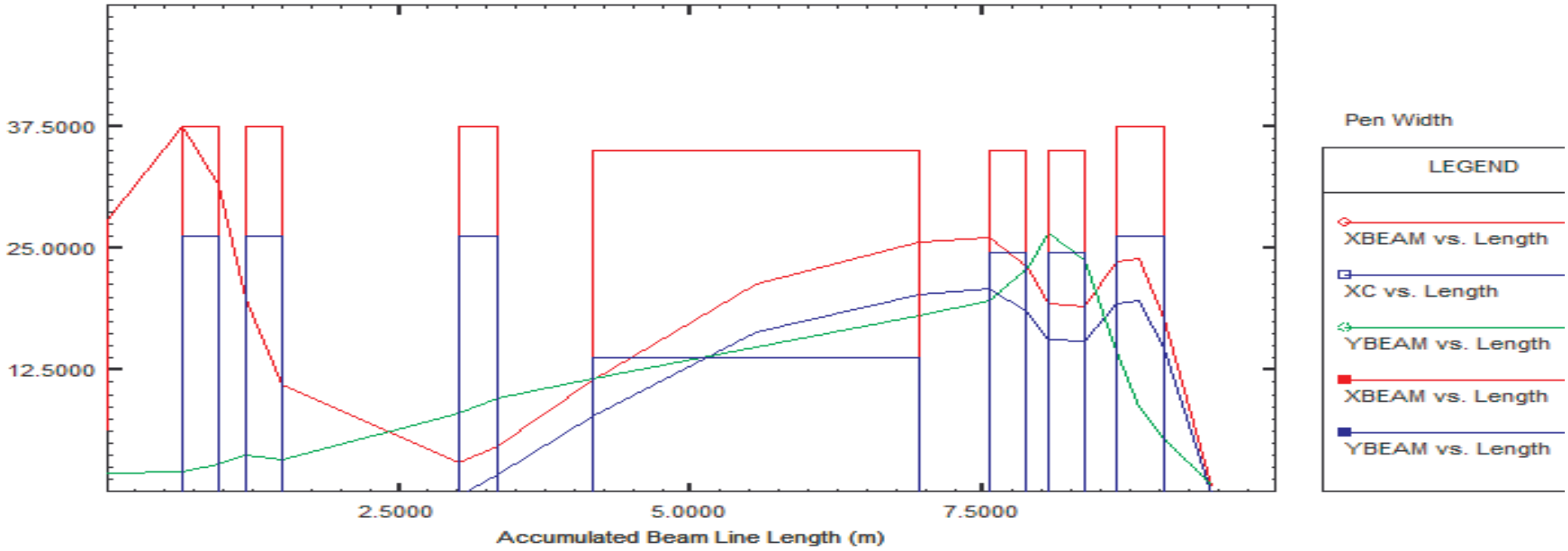


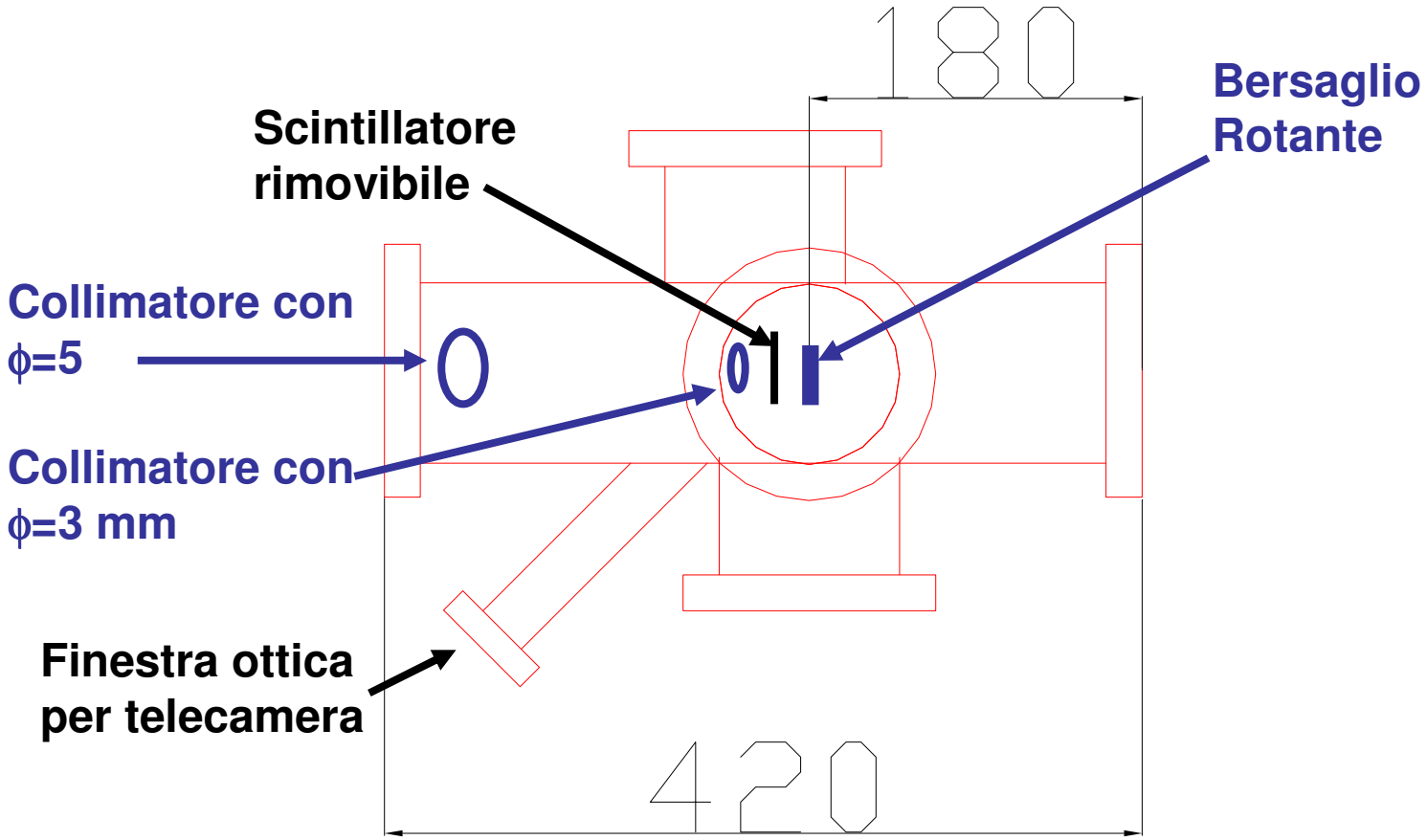
Fig. 35 - Radial and axial phase spaces at the exit point for four ions extracted at field level. No magnetic channel is assumed in the yoke traversal.

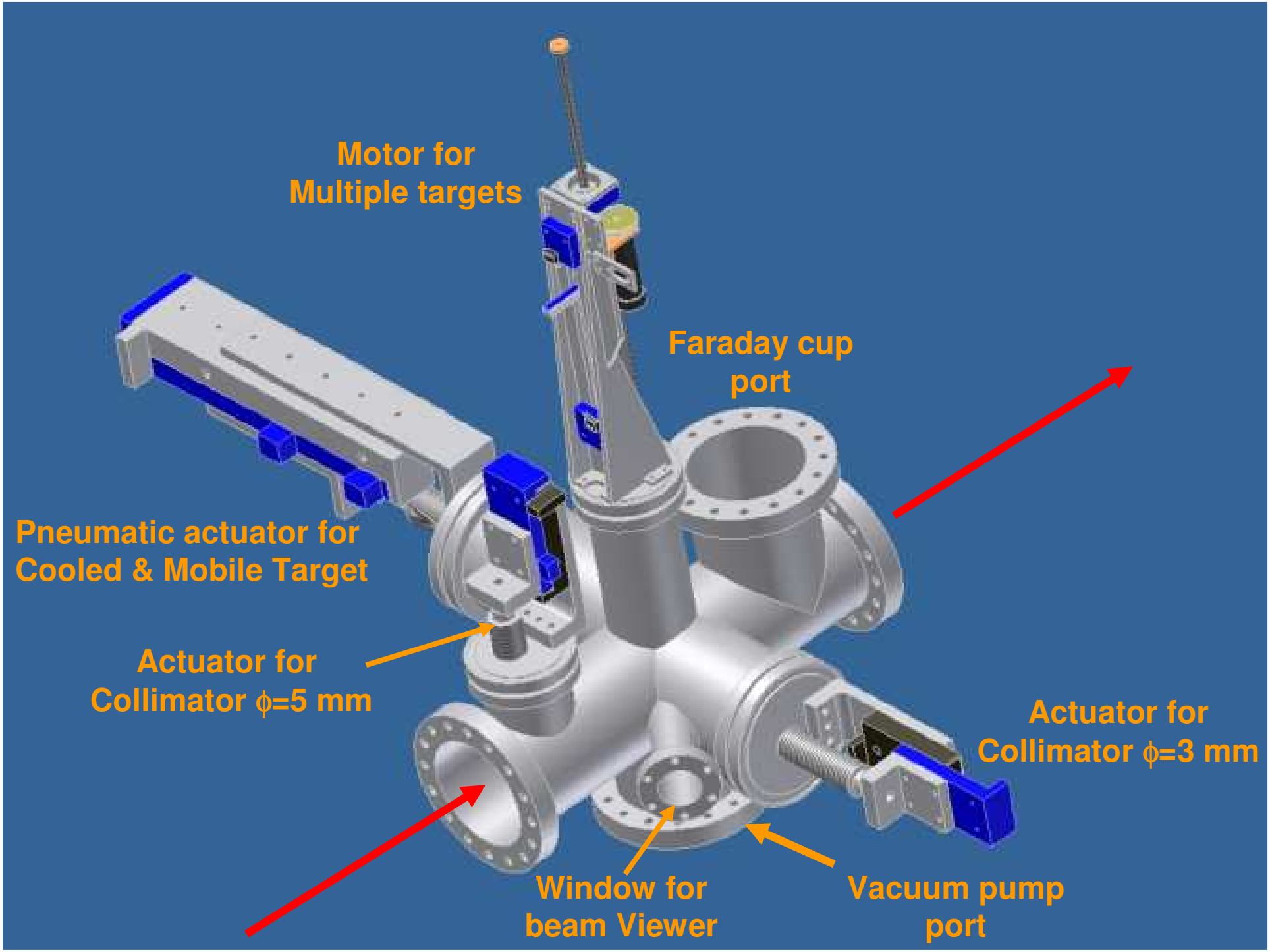

37.5000
25.0000
12.5000
2.5000
5.0000
7.5000
Accumulated Beam Line Length (m)
Pen Width
LEGEND
XBEAM vs. Length
XC vs. Length
YBEAM vs. Length
XBEAM vs. Length
YBEAM vs. Length

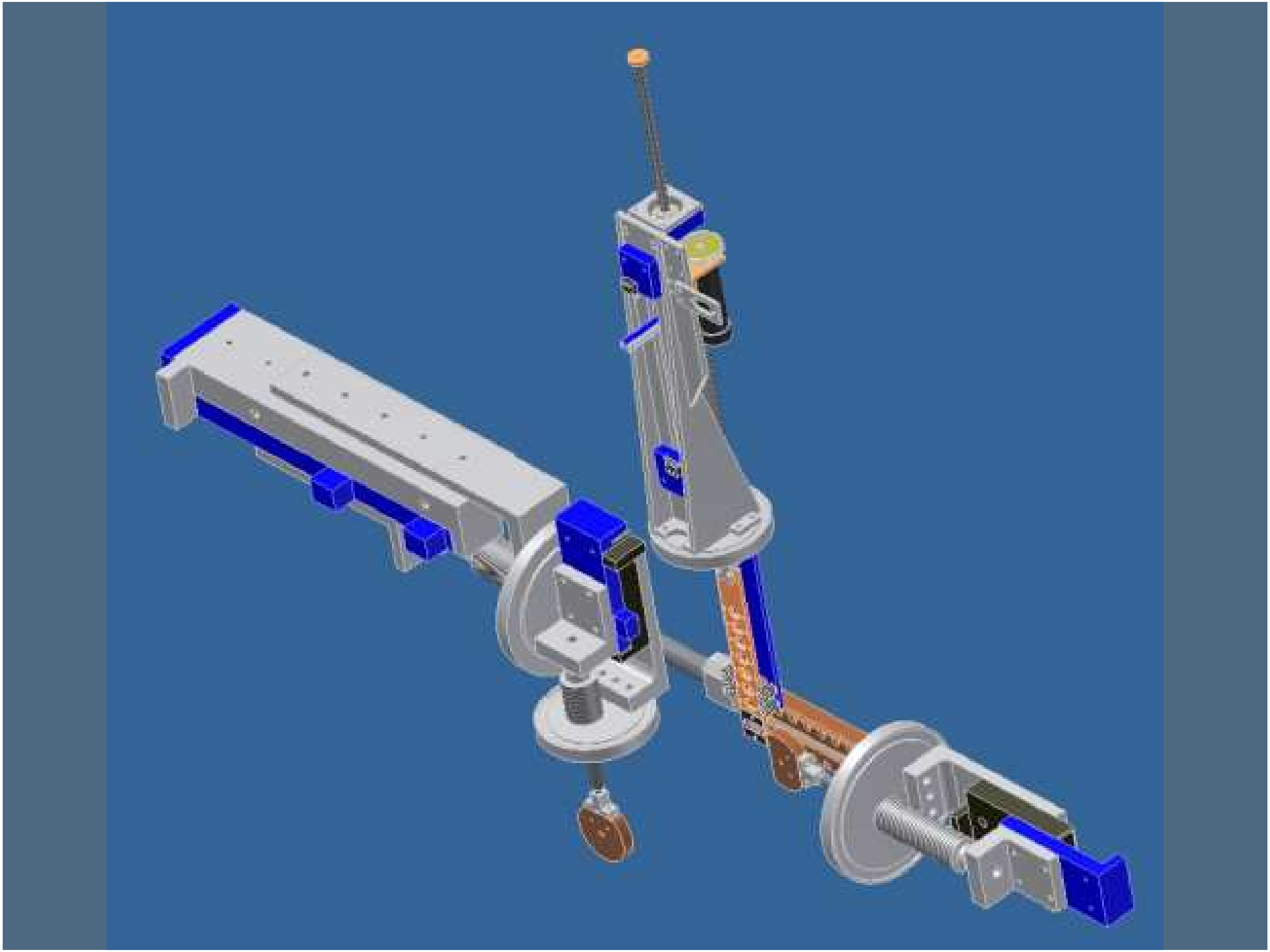

37.5000
25.0000
12.5000
2.5000
5.0000
7.5000
Accumulated Beam Line Length (m)
Pen Width
LEGEND
XBEAM vs. Length
XC vs. Length
YBEAM vs. Length
XBEAM vs. Length
YBEAM vs. Length

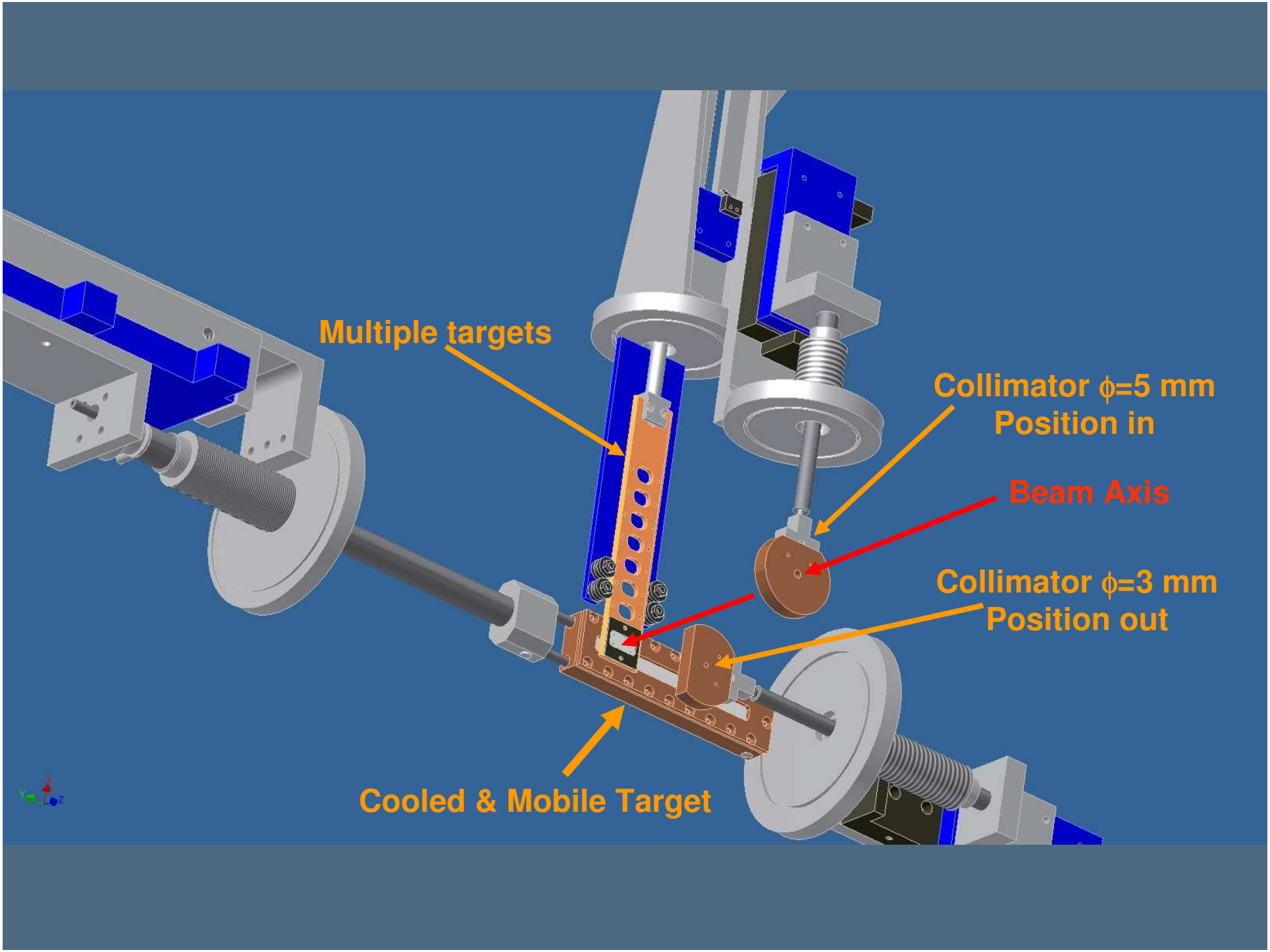
case	E	BR	Q1	Q2	Q3	Q4	Q5	Q6	Q6	D-q4	Dlast	Xf	Yf	Ltot
q/A	MeV/n	Tm	kG	kG	kG	kG	kG	kG	kG	cm	cm	mm	mm	m
			Φ=75	Φ=75	Φ=75	Φ=70	Φ=70	Φ=50	Φ=75					
			L=30	L=30	L=30	L=31	L=31	L=42	L=42					
			Bmx	Bmx	Bmx	Bmx	Bmx	Bmx	Bmx					
			7	7	7	7.7	7.7	8.6	6.75					
1-0.5	100.5	2.9635	3.399	-3.634	-0.390	2.687	-7.084		6.7	35+27	35	**0.754**	**0.879**	9.38
1-0.5	100.5	2.9635	3.522	-2.909	-1.126	2.148	-7.016		6.7	35+27	45	**0.7**	**0.7**	9.48
2-0.5	44,01	1.9325	4.288	-6.96	-1.283	1.937	-4.72		5.03	35+27	35	**0.55**	**0.7**	9.38
2-0.5	44,01	1.9325	4.287	-6.96	-1.252	1.761	-4.43		4.40	35+27	45	**0.55**	**0.69**	9.48
3-0.4	27.59	1.9046	2.493	-0.780	-1.838	1.982	-4.97		5.13	35+27	35	**0.57**	**0.7**	9.38
3-0.4	27.59	1.9046	2.482	-0.789	-1.457	1.987	-5.17		4.57	35+27	45	**0.61**	**0.7**	9.48
4-0.3	58,53	3.765	2.832	-3.489	3.167	-3.976	1.331		6.7	35+27	35	**0.79**	**0.7**	9.38
4-0.3	58,53	3.765	2.986	-4.266	5.506	-3.973	1.207		6.7	35+27	40	**0.81**	**0.7**	9.43
4-0.3	58,53	3.765	4.106	-4.169	3.519	-3.946	1.298		6.7	35+27	45	**0.9**	**0.7**	9.48
4b-0.3	58,53	3.765	3.714	-6.805	2.809	-3.249	-0.797		6.7	35+27	45	**0.93**	**0.7**	9.48
5-0.3	15,12	1.8735	3.718	-3.509	1.919	7.6	-6.67		6.5	35+27	35	**0.55**	**0.7**	9.38
5-0.3	15,12	1.8735	4.104	-3.497	2.129	7.6	-6.623		6.5	35+27	45	**0.65**	**0.7**	9.48
6-0.25	49,42	4.102	6.056	-6.874	4.844	-4.675	1.86		6.75	35+27	35	**0.729**	**0.74**	9.38
6-0.25	49,42	4.102	6.076	-6.855	4.895	-4.12	0.487		6.75	35+27	45	**0.688**	**0.73**	9.48
7-0.1	8.04	4.09	5.869	-7.0	3.822	2.151	7.7		6.75	35+27	45	1.99	1.47	9.48

Flange CF-100




Motor for
Multiple targets
Faraday cup
port
Pneumatic actuator for
Cooled & Mobile Target
Actuator for
Collimator ϕ=5 mm
Actuator for
Collimator ϕ=3 mm
Window for
beam Viewer
Vacuum pump
port




Multiple targets
Collimator ϕ=5 mm
Position in
Beam Axis
Collimator ϕ=3 mm
Position out
Cooled & Mobile Target