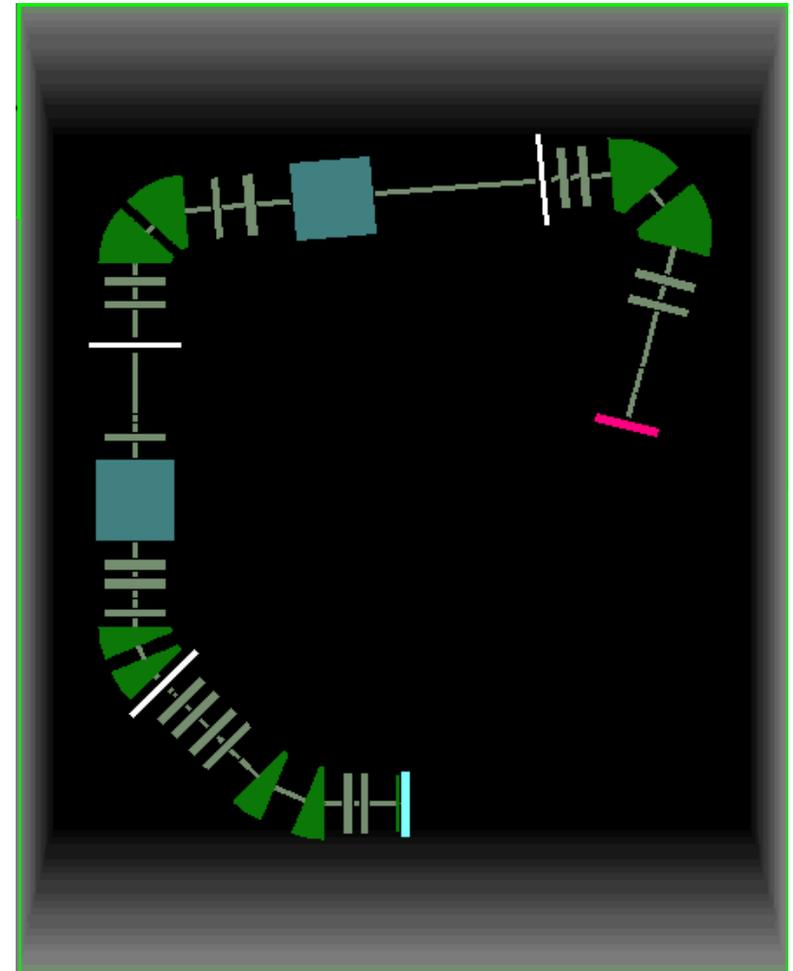


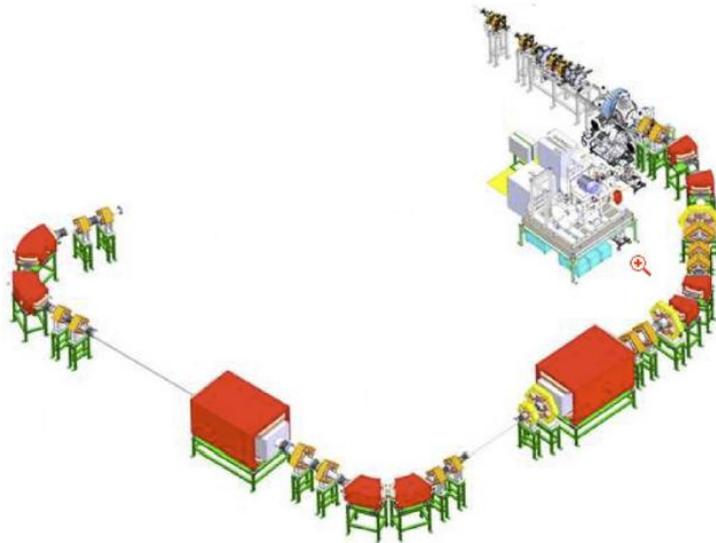
Version 9.10.169  
from 08/20/2015

[Link: Separator “SECAR”](#)

- SECAR extended configurations
  - SECAR documentation
  - SECAR phase1
  - LISE++ modifications for SECAR
  - SECAR files location
  - SECAR phase 1 with COSY maps
  - Optimization with LISE++
- SECAR phase1: Angular Acceptance
- SECAR phase1: Momentum Acceptance
- SECAR phase1: Charge states selection
- Experiment  $^{15}\text{O}(\alpha,\gamma)^{19}\text{Ne}$ 
  - Fusion
  - De-excitation by gamma at low energies vs. kinematics
- Segmented configuration
- Open questions



## 1. SEparator for CApture Reactions (SECAR) Pre-Conceptual Design Report



Facility for Rare Isotope Beams

FRIB-M41600-RP-000055-R002

*SEparator for CApture Reactions (SECAR) Pre-Conceptual Design Report*

Issued 1 October 2014

### SEparator for CApture Reactions (SECAR) Pre-Conceptual Design Report

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## 2. COSY file “inputCOSY-MC-4.fox” by G.Berg & M.Couder (Notre Dame)

Helpful information for the recent recoil separator development in LISE++:  
*Documentation for extended configurations of the recoil separator “DRAGON” @ TRIUMF*  
[http://lise.nsl.msui.edu/9\\_10/DRAGON/DRAGON.pdf](http://lise.nsl.msui.edu/9_10/DRAGON/DRAGON.pdf)

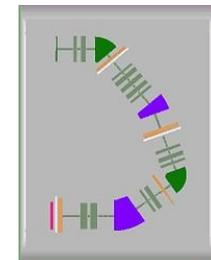


Table 3.3. The optimized longitudinal locations and lengths of the various SECAR ele

Element		Element properties					
Technical Name	Description	“Effective” Length(m)/ angle(deg) 1VF/2VF	Radius/half gap (m)				
DL1	Drift	0.8		VF1	Velocity filter	2.365	0.11
Q1	Quad+Hex	0.25	0.05	DL19	Drift	0.50	
DL2	Drift	0.19		HEX3	Hexapole	0.26	0.11
Q2	Quad	0.30	0.068	DL20	Drift	0.28	
DL3	Drift	0.58		OCT1	Octupole	0.26	0.07
B1	Dipole	22.5 deg	1.25/0.03	DL21	Drift	1.75	
DL4	Drift	1.00		DL22	Drift	0.872	
B2	Dipole	22.5 deg	1.25/0.03	Q8	Quad	0.25	0.05
DL5	Drift	0.77		DL23	Drift	0.395	
DL6	Drift	0.40		Q9	Quad	0.30	0.06
HEX1	Hexapole	0.26	0.11	DL24	Drift	0.36	
DL7	Drift	0.27		B5	Dipole	42.5 deg	1.25/ 0.03
Q3	Quad	0.35	0.11	DL25	Drift	0.35	
DL8	Drift	0.35		B6	Dipole	42.5 deg	1.25/0.03
Q4	Quad	0.35	0.08	DL26	Drift	0.83	
DL9	Drift	0.21		Q10	Quad	0.26	0.09
Q5	Quad	0.35	0.06	DL27	Drift	0.65	
DL10	Drift	0.145		Q11	Quad	0.34	0.12
DL11	Drift	0.185		DL28	Drift	1.00	
DL12	Drift	0.17		VF2	Velocity filter	2.365	0.11
B3	Dipole	22.5 deg	1.25/0.05	DL29	Drift	4.60	
DL13	Drift	0.51		DL30	Drift	0.25	
B4	Dipole	22.5 deg	1.25/0.05	Q12	Quad	0.30	0.07
DL14	Drift	0.30		DL31	Drift	0.30/0.35	
HEX2	Hexapole	0.26	0.12	Q13	Quad	0.30	0.05
DL15	Drift	0.27		DL32	Drift	0.66	
DL16	Drift	0.27		B7	Dipole	55.0 deg	1.25/0.03
Q6	Quad	0.34	0.14	DL33	Drift	0.68	
DL17	Drift	0.20		B8	Dipole	55.0 deg	1.25/ 0.03
Q7	Quad	0.34	0.13	DL34	Drift	0.86	
DL18	Drift	0.50		Q14	Quad	0.30	0.05
				DL35	Drift	0.45	
				Q15	Quad	0.30	0.05
				DL36	Drift	1.70/1.21	
				DL37	Drift	0.75/1.10	
				DL38	Drift	0.75/0.40	

## Dipoles

	Units	Parameter							
		B1	B2	B3	B4	B5	B6	B7	B8
Bending radius	mm	1250	1250	1250	1250	1250	1250	1250	1250
Maximum rigidity	Tm	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Max. magnetic field B	T	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64
Bending angle, to right	deg	22.5	22.5	22.5	22.5	42.5	42.5	55.0	55.0
Central ray, arc length	mm	490.9	490.9	490.9	490.9	927.2	927.2	1199.9	1199.9
Vertical gap, full size	mm	60	60	100	100	60	60	60	60
GFR, dB/B <+/-0.02%	mm	200	200	100	200	100	100	100	100
Pole width	mm	380	380	400	500	300	300	280	280
Entrance s <sub>11</sub>		0.1900	0.1150	0.1900	0.1900	0.1890	0.1970	0	0
Entrance s <sub>12</sub>	1/m	0.0025	0.0125	1.07	-0.339	0.696	-1.66	0	0
Entrance s <sub>13</sub>	1/m <sup>2</sup>	0.154	0.198	-9.10	-5.51	-0.953	-50..	0	0
Entrance s <sub>14</sub>	1/m <sup>3</sup>	0.78	-40.77	0.	-0.84	-53.	0.	0	0
Exit s <sub>21</sub>		0.1500	0.1150	0.1150	0.1900	-0.172	0.200	0	0
Exit s <sub>22</sub>	1/m	-0.019	-0.2448	0.0410	-0.030	-5.928	-4.00	0	0
Exit s <sub>23</sub>	1/m <sup>2</sup>	0.147	1.411	32.7	-0.364	-26.5	69.	0	0
Exit s <sub>24</sub>	1/m <sup>3</sup>	0.10	37.47	-57.	-0.15	-940..	0.	0	0

Table 3.10. Specifications of SECAR Velocity Filters

Good-field Region (GFR)	Horizontal Vertical	mm mm	± 110 ± 35
Dipole Magnet	Max. B field in GFR	T	0.12
	Effective field length	mm	2365
	Pole gap, vertical	mm	900
	Pole width, approx..	mm	1020
	B field, homogeneity		± 0.0002 in GFR
	Estimated power	kW	50
	Iron weight	kg	12800
2 Coils Weight	kg	2300	
Electrostatic system	Max. E field in GFR	kV/mm	2.7
	Max. Voltages on electrodes	kV	+/- 300
	Effective field length	mm	2365
	Electrode gap, horizontal	mm	220
	Electrode height, vertical	mm	538

Table 3.4. Quadrupole and multipole field settings for the SECAR C charge state 21, energy 206 MeV.

Quadrupole	Radius (m)	Pole tip field (T)	Gradient T/m
Q1	0.05	-0.3654	-7.3080000
Q2	0.068	0.217880	3.2041176
Q3	0.11	0.242643	2.2058455
Q4	0.08	-0.24501	-3.0626250
Q5	0.06	0.1112810	1.8546833
Q6	0.14	0.181721	1.2980071
Q7	0.13	-0.0301435	-0.2318731
Q8	0.05	-0.15032	-3.0064000
Q9	0.06	0.23438	3.3482857
Q10	0.09	-0.03250	-0.3611111
Q11	0.12	0.1616	1.3466667
Q12	0.07	-0.1820	-2.6000000
Q13	0.05	0.1910	3.8200000
Q14	0.05	0.1290	2.5800000
Q15	0.05	-0.138	-2.7600000
HEX(Q1)	0.05	-0.00289	
HEX1	0.11	0.0103064	
HEX2	0.12	0.011057	
HEX3	0.11	-0.01251	

For SECAR phase1

	REPORT from October 2014	COSY file, table v4
<b>element</b>	<b>T</b>	<b>T</b>
Q1	-0.3654	-0.3653
Q2	0.2179	0.2179
Q3	0.2426	0.2426
Q4	-0.2450	-0.2450
Q5	0.1113	0.1113
Q6	0.1817	0.1817
Q7	-0.0301	-0.0301
Q8	-0.1503	
Q9	0.2344	
Q10	-0.0325	
Q11	0.1616	
Q12	-0.1820	-0.2200
Q13	0.1910	0.2016
Q14	0.1290	0.1315
Q15	-0.1380	-0.1450
HEX(Q1)	-0.0029	-0.0006
HEX1	0.0103	0.0086
HEX2	0.0111	0.0145
HEX3	-0.0125	-0.0434

The optimized ion optics setup was calculated for the transmission of "reference" ions with mass 66, charge 21, and a laboratory energy of 206 MeV corresponding to 3.12 MeV center of mass energy. These ions correspond to the recoiling <sup>66</sup>Se ions from the <sup>65</sup>As(p,γ)<sup>66</sup>Se reaction, and have the maximum magnetic rigidity of  $B\rho = 0.800$  Tm. The field settings for recoils from any particular reaction are then determined by appropriately scaling the optimized settings by the ratio of magnetic rigidities. The lowest design rigidity for our system is 0.14 Tm. In the optimized setup, the maximum design rigidity of 0.8 Tm and a dipole magnet with bending radius of 1.25 m require dipole fields of 0.64 T. The pole tip fields and pole tip radii of the quadrupoles, hexapoles, octupole, and multipole strengths are listed in Table 3.4. The optimum field settings of the velocity filter are 0.1143 T magnetic field and +/- 308.3 kV for the HV on the electrodes, corresponding to an electric field of 2.80kV/mm. Component specifications for the velocity filters are given in Table 3.9 in §3.7.3. The bending radii for the magnetic and electric fields in the velocity filters correspond to 7 m for both the electric and the magnetic fields.

Beam in LISE++

# SECAR settings in LISE<sup>++</sup> : target – FP2

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
N	Block name	Kind of	Start	Length	DriftMode	B0 (kG)	Br-corrsp	Rapp (cm)	L_eff (m)	2nd	Calc	AngAcc	Slits	Xmin	Xmax	Ymin	Ymax	Appert	Xmin	Xmax	Ymin	Ymax
or		Block	(m)	(m)	Angle (°) *		Br-dip* R(m)*		Len(m)*	order	Mode	mode	shape	slit	slit	slit	slit	shape	limit	limit	limit	limit
1.	tuning	Dipole	0.000	0.000	+0.0 *	+2.667	0.8000*	3.00*	0.00*	-	--	rectn						ellps	-50	+50	-50	+50
2.	dl1	Drift	0.000	0.800	standard						--	rectn						ellps	-50	+50	-50	+50
3.	Q1	Drift	0.800	0.250	multipole	-3.653	0.8000	5.00	0.25	yes	1	--	rectn					ellps	-50	+50	-50	+50
4.	dl2	Drift	1.050	0.190	standard						--	rectn						ellps				
5.	Q2	Drift	1.240	0.300	multipole	+2.179	0.8000	6.80	0.30	yes	1	--	rectn					ellps	-68	+68	-68	+68
6.	dl3	Drift	1.540	0.580	standard						--	rectn						ellps				
7.	B1	Dipole	2.120	0.491	+22.5 *	+2.667	0.8000*	1.25*	0.49*	yes	--	rectn						rectn			-30	+30
8.	dl4	Drift	2.611	1.000	standard						--	rectn						rectn				
9.	B2	Dipole	3.611	0.491	+22.5 *	+2.667	0.8000*	1.25*	0.49*	yes	--	rectn						rectn			-30	+30
10.	dl5	Drift	4.102	0.770	standard						--	rectn						rectn				
11.	dl6	Drift	4.872	0.400	standard						--	rectn						rectn				
12.	Hex1	Drift	5.272	0.260	multipole	+0.000	0.8000	11.00	0.26	yes	1	--	rectn					ellps	-110	+110	-110	+110
13.	dl7	Drift	5.532	0.270	standard						--	rectn						rectn				
14.	Q3	Drift	5.802	0.350	multipole	+2.426	0.8000	11.00	0.35	yes	1	--	rectn					ellps	-110	+110	-110	+110
15.	dl8	Drift	6.152	0.350	standard						--	rectn						rectn				
16.	Q4	Drift	6.502	0.350	multipole	-2.450	0.8000	8.00	0.35	yes	1	--	rectn					ellps	-80	+80	-80	+80
17.	dl9	Drift	6.852	0.210	standard						--	rectn						rectn				
18.	Q5	Drift	7.062	0.350	multipole	+1.113	0.8000	6.00	0.35	yes	1	--	rectn					ellps	-60	+60	-60	+60
19.	dl10	Drift	7.412	0.145	standard						--	rectn						rectn				
20.	dl11	Drift	7.557	0.185	standard						--	rectn						rectn				
21.	slits FP1	Drift	7.742	0.000	SLITS						--	rectn	-100	+100	-50	+50		rectn				
22.	dl12	Drift	7.742	0.170	standard						--	rectn						rectn				
23.	B3	Dipole	7.912	0.491	+22.5 *	+2.667	0.8000*	1.25*	0.49*	yes	--	rectn						rectn			-50	+50
24.	dl13	Drift	8.403	0.510	standard						--	rectn						rectn			-50	+50
25.	B4	Dipole	8.913	0.491	+22.5 *	+2.667	0.8000*	1.25*	0.49*	yes	--	rectn						rectn			-50	+50
26.	dl14	Drift	9.403	0.300	standard						--	rectn						rectn				
27.	Hex2	Drift	9.703	0.260	multipole	+0.000	0.8000	12.00	0.26	yes	1	--	rectn					ellps	-120	+120	-120	+120
28.	dl15	Drift	9.963	0.270	standard						--	rectn						rectn				
29.	dl16	Drift	10.233	0.270	standard						--	rectn						rectn				
30.	Q6	Drift	10.503	0.340	multipole	+1.817	0.8000	14.00	0.34	yes	1	--	rectn					ellps	-140	+140	-140	+140
31.	dl17	Drift	10.843	0.200	standard						--	rectn						rectn				
32.	Q7	Drift	11.043	0.340	multipole	-0.301	0.8000	13.00	0.34	yes	1	--	rectn					ellps	-130	+130	-130	+130
33.	dl18	Drift	11.383	0.500	standard						--	rectn						ellps				
34.	VF1	Wien	11.883	2.365							--	rectn						rectn	-110	+110	-35	+35
35.	dl19	Drift	14.248	0.500	standard						--	rectn						rectn				
36.	Hex3	Drift	14.748	0.260	multipole	+0.000	0.7999	11.00	0.26	yes	1	--	rectn					ellps	-110	+110	-110	+110
37.	dl20	Drift	15.008	0.280	standard						--	rectn						rectn				
38.	Oct1	Drift	15.288	0.260	standard						--	rectn						ellps	-70	+70	-70	+70
39.	dl21	Drift	15.548	1.750	standard						--	rectn						rectn				
40.	slits FP2	Drift	17.298	0.000	SLITS						--	rectn	-150	+150	-100	+100		rectn				



This settings list can be produced in LISE<sup>++</sup> using menu "Experimental Settings -> Optics -> Optics settings: View and Print"

These aperture parameters are used to obtain angular and momentum acceptances of the separator.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
N	Block name	Kind of Block	Start (m)	Length (m)	DriftMode	B0 (kG)	Br-corrsp	Rapp (cm)	L_eff (m)	2nd order	Calc Mode	AngAcc mode	Slits shape	Xmin slit	Xmax slit	Ymin slit	Ymax slit	Appert shape	Xmin limit	Xmax limit	Ymin limit	Ymax limit
41.	dl22	Drift	17.298	0.872	standard							--	rectn					rectn				
42.	Q8	Drift	18.170	0.250	multipole	-1.503	0.7999	5.00	0.25	yes	1	--	rectn					ellps	-50	+50	-50	+50
43.	dl23	Drift	18.420	0.395	standard							--	rectn					rectn				
44.	Q9	Drift	18.815	0.300	multipole	+2.343	0.7999	6.00	0.30	yes	1	--	rectn					ellps	-60	+60	-60	+60
45.	dl24	Drift	19.115	0.360	standard							--	rectn					rectn				
46.	B5	Dipole	19.475	0.927	+42.5 *	+2.667	0.8000*	1.25*	0.93*	yes		--	rectn					rectn			-30	+30
47.	dl25	Drift	20.403	0.350	standard							--	rectn					rectn				
48.	B6	Dipole	20.753	0.927	+42.5 *	+2.667	0.8000*	1.25*	0.93*	yes		--	rectn					rectn			-30	+30
49.	dl26	Drift	21.680	0.830	standard							--	rectn					rectn				
50.	Q10	Drift	22.510	0.260	multipole	-0.325	0.8000	9.00	0.26	yes	1	--	rectn					ellps	-90	+90	-90	+90
51.	dl27	Drift	22.770	0.650	standard							--	rectn					rectn				
52.	Q11	Drift	23.420	0.340	multipole	+1.616	0.8000	12.00	0.34	yes	1	--	rectn					ellps	-120	+120	-120	+120
53.	dl28	Drift	23.760	1.000	standard							--	rectn					rectn				
54.	VF2	Wien	24.760	2.365								--	rectn					rectn	-110	+110	-35	+35
55.	dl29	Drift	27.125	4.600	standard							--	rectn					rectn				
56.	slits FP3	Drift	31.725	0.000	SLITS							--	rectn	-150	+150	-100	+100	rectn				
57.	dl30	Drift	31.725	0.250	standard							--	rectn					rectn				
58.	Q12	Drift	31.975	0.300	multipole	-1.820	0.7999	7.00	0.30	yes	1	--	rectn					ellps	-70	+70	-70	+70
59.	dl31	Drift	32.275	0.300	standard							--	rectn					rectn				
60.	Q13	Drift	32.575	0.300	multipole	+1.910	0.7999	5.00	0.30	yes	1	--	rectn					ellps	-50	+50	-50	+50
61.	dl32	Drift	32.875	0.660	standard							--	rectn					rectn				
62.	B7	Dipole	33.535	1.200	+55.0 *	+2.667	0.8000*	1.25*	1.20*	yes		--	rectn					rectn			-30	+30
63.	dl33	Drift	34.735	0.680	standard							--	rectn					rectn				
64.	B8	Dipole	35.415	1.200	+55.0 *	+2.667	0.8000*	1.25*	1.20*	yes		--	rectn					rectn			-30	+30
65.	dl34	Drift	36.615	0.860	standard							--	rectn					rectn				
66.	Q14	Drift	37.475	0.300	multipole	+1.290	0.8000	5.00	0.30	yes	1	--	rectn					ellps	-50	+50	-50	+50
67.	dl35	Drift	37.775	0.450	standard							--	rectn					rectn				
68.	Q15	Drift	38.225	0.300	multipole	-1.380	0.8000	5.00	0.30	yes	1	--	rectn					ellps	-50	+50	-50	+50
69.	dl36	Drift	38.525	1.700	standard							--	rectn					rectn				
70.	dl37	Drift	40.225	0.750	standard							--	rectn					rectn				
71.	dl38	Drift	40.975	0.750	standard							--	rectn					rectn				

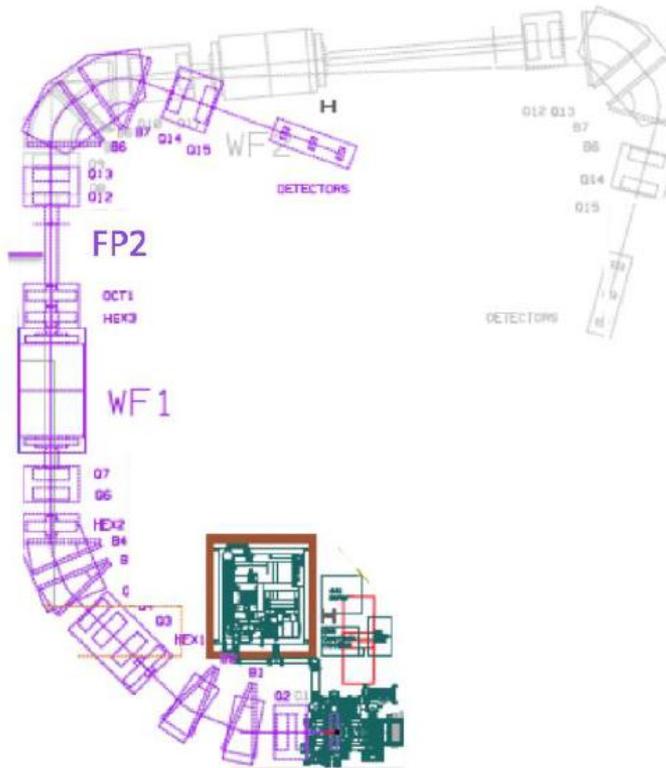


This settings list can be produced in LISE<sup>++</sup> using menu "Experimental Settings -> Optics -> Optics settings: View and Print"

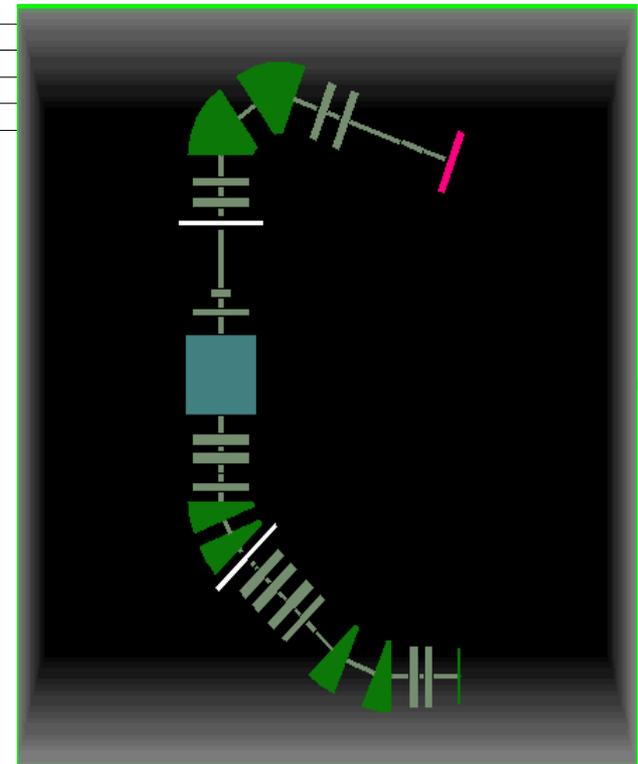
These aperture parameters are used to obtain angular and momentum acceptances of the separator.

Table 3.13. SECAR Optimized Setup for a 1 VF system

Quadrupole	Radius (m)	Pole tip field (T)	Gradient T/m
Q1	0.05	-0.36534	-7.3068000
Q2	0.068	0.21788	3.2041176
Q3	0.11	0.242644	2.2058545
Q4	0.08	-0.24501	-3.0626250
Q5	0.06	0.11128	1.8546667
Q6	0.14	0.181721	1.2980071
Q7	0.13	-0.0301475	-0.2319038
Q8			
Q9			
Q10			
Q11			
Q12	0.07	-0.22000	-3.1428571
Q13	0.05	0.20160	4.0320000
Q14	0.05	0.13147	2.6294000
Q15	0.05	-0.1450	-2.9000000
HEX(Q1)	0.05	-0.0006	
HEX1	0.11	0.008620	
HEX2	0.12	0.01449	
HEX3	0.11	-0.0435	
OCT1	0.07	0.006225	



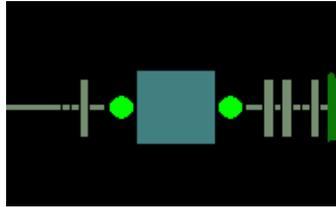
@ LISE++



## SECAR Wien filter in LISE<sup>++</sup>

Up to v.9.10.164 only clockwise bending direction

	Rotate 1	Angle	180 deg
	VF1	E	2800 KV/m
		B	1142.93 G
		DL	-3.93 mm/%
	Rotate 2	Angle	180 deg



## SECAR Wien filter in COSY

```
CB;
WF 7.0 7.0 2.365 0.11 ;
CB;
{WF1}
```

Block matrix

1. X	0.94766	2.32124	0	0	0	3.93094
2. T	-0.04391	0.94766	0	0	0	3.2983
3. Y	0	0	1	2.365	0	0
4. P	0	0	0	1	0	0
5. L	-0.32983	-0.39309	0	0	1	-0.45165
6. D	0	0	0	0	0	1

Det = 0.99999

Wien velocity filter

Link to COSY map

WF1.TXT

v.9.10.165

VF1

Wien Velocity Filter settings

Select constant field

Electric field E = 2800 KV/m

Magnetic field B = 1142.926 Gauss

Dispersion: 3.931 mm/%

Filter settings correspond to a Bhro-value for the setting fragment: 0.8000 Tm

Separation velocity plane

Horizontal (VAMOS)

Vertical (LISE3)

Bending direction

Clockwise (default)

Counterclockwise

Optical block properties and data

Section-Element construction property

S-block (Section)  E-block (Element)

Setting Charge state for the Block (Z-Q): 13

Calculate the Values using the Setting fragment from

Cut (Slits) & Acceptances: B4

Optical matrix: B7

General setting of block: Tweak 0.1 %

Utilities

Wien-filter transport matrix calculation

"Classical" solution for the Dispersion coefficient: 9.36e-5

Allow remote matrices calculation

	VF1	E	2800 KV/m
		B	1142.93 G
		DL	3.93 mm/%

We do not need more rotation blocks

Block matrix

1. X	0.94383	2.32055	0	0	0	3.93137
2. T	-0.04705	0.94383	0	0	0	3.29318
3. Y	0	0	1	2.365	0	0
4. P	0	0	0	1	0	0
5. L	0	0	0	0	1	0
6. D	0	0	0	0	0	1

Det = 1.00000

Wien velocity filter

Link to COSY map

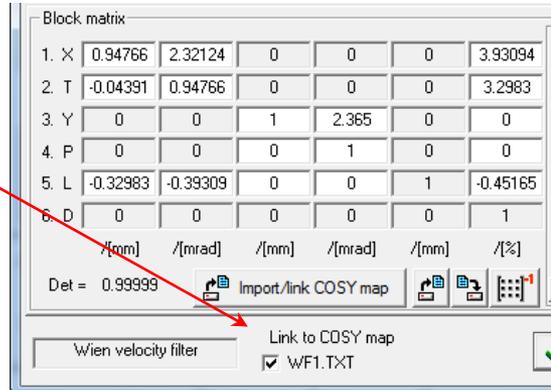
WF1.TXT

## v.9.10.168

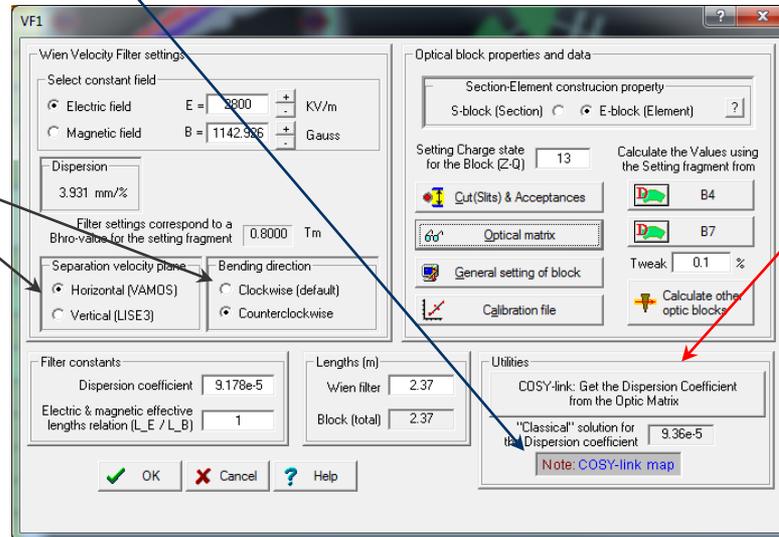
- Wien filter dispersion is “floating” for each ion in LISE<sup>++</sup>, and is calculated based on the Dispersion coefficient.
- A new option has been developed for consistency in the case of COSY linked map

- Link a COSY map to LISE<sup>++</sup> block

you will get the message later in the Wien filter dialog



- Set correct Selection and Bending directions

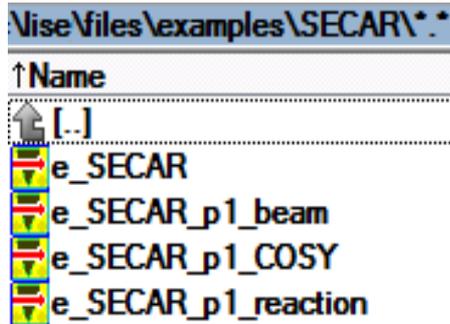


- Click the button

COSY-link: Get the Dispersion Coefficient from the Optic Matrix

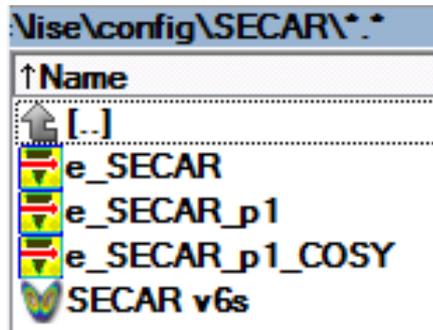
to calculate the dispersion coefficient corresponding to the COSY map.  
*This coefficient will be valid for all fragments at different energies*

## LISE<sup>++</sup> files



- *SECAR extended for primary beam (not optimized yet)*
- *SECAR phase1 extended for primary beam*
- *SECAR phase1 extended with COSY 5<sup>th</sup> order maps*
- *SECAR phase1 extended :  $^{15}\text{O}(\alpha, \gamma)^{19}\text{Ne}$*

## LISE<sup>++</sup> configurations



- *SECAR extended configurations*
- *COSY file to generate SECAR maps for LISE<sup>++</sup>*

SECAR segmented configurations will be done soon

File: e\_SECAR\_p1\_COSY.lpp

Optics settings (fast editing)

Block	Given Name	Start(m)	Length(m)	B0(kG)*U	Br(TM)cor/*real	DriftM/*Angle	Rapp(cm)*R(...)	Leff(m)*Ldip(m)	2 nd order	CalcMatr/*Z-Q	AngAcc.Apps.Slits	COSY IFit	SE
Dipole	tuning	0.000	0.0000	+2.6667	* 0.8000	* +0.0	* 3.0000	* 0.0000	-	* 13	-- HV --	-	S
drift	dl1	0.000	0.8000			standard					-- HV --	-	e
<Quad>	Q1	0.800	0.2500	-3.6534	0.8000	MULT	5.0000	0.2500	yes (5)	1	-- HV --	cosy	e
drift	dl2	1.050	0.1900			standard					-- -- --	-	e
<Quad>	Q2	1.240	0.3000	+2.1788	0.8000	QUAD	6.8000	0.3000	yes (5)	1	-- HV --	cosy	e
drift	dl3	1.540	0.5800			standard					-- -- --	-	e
Dipole	B1	2.120	0.4909	+6.4000	* 0.8000	* +22.5	* 1.2500	* 0.4909	yes (5)	* 13	-- -V --	cosy	E
drift	dl4	2.611	1.0000			standard					-- -- --	-	e
Dipole	B2	3.611	0.4909	+6.4000	* 0.8000	* +22.5	* 1.2500	* 0.4909	yes (5)	* 13	-- -V --	cosy	E
drift	dl5	4.102	0.7700			standard					-- -- --	-	e
drift	dl6	4.872	0.4000			standard					-- -- --	-	e
<Quad>	Hex1	5.272	0.2600	+0.0862	0.8000	SEXT	11.0000	0.2600	yes (5)	1	-- HV --	cosy	e
drift	dl7	5.532	0.2700			standard					-- -- --	-	e
<Quad>	Q3	5.802	0.3500	+2.4264	0.8000	QUAD	11.0000	0.3500	yes (5)	1	-- HV --	cosy	e
drift	dl8	6.152	0.3500			standard					-- -- --	-	e
<Quad>	Q4	6.502	0.3500	-2.4501	0.8000	QUAD	8.0000	0.3500	yes (5)	1	-- HV --	cosy	e
drift	dl9	6.852	0.2100			standard					-- -- --	-	e
<Quad>	Q5	7.062	0.3500	+1.1128	0.8000	QUAD	6.0000	0.3500	yes (5)	1	-- HV --	cosy	e
drift	dl10	7.412	0.1450			standard					-- -- --	-	e
drift	dl11	7.557	0.1850			standard					-- -- --	-	e
_slits_	slits FP1	7.742	0.0000			SLITS					-- -- HV	-	e
drift	dl12	7.742	0.1700			standard					-- -- --	-	e
Dipole	B3	7.912	0.4909	+6.4000	* 0.8000	* +22.5	* 1.2500	* 0.4909	yes (5)	* 13	-- -V --	cosy	E

Selected block: Dispersive (M-dipole) | Block Length [m]: 0 | Selected Block Edit | Multipole Edit | Cuts (Acceptances) | Optical Matrix | Charge State [Z-Q] = 13

Angular acceptance (mrad): Horizontal ± [ ] [ ] Use [ ] | Vertical ± [ ] [ ] Use [ ] | Shape: Rectangle [ ] Ellipse [x]

Inside Aperture (mm): X = min: -50 max: 50 Use [x] | Y = min: -50 max: 50 Use [x] | Shape: Rectangle [ ] Ellipse [x]

Slits (mm) after this BLOCK: X = min: [ ] max: [ ] Use [ ] | Y = min: [ ] max: [ ] Use [ ] | Shape: Rectangle [x] Ellipse [ ]

1-st order Matrix Elements: Matrix Plot | Beam-Sigma Plot | View | Quit | Help

Blocks are linked with 5<sup>th</sup> order COSY maps

## List of blocks with 5<sup>th</sup> order COSY maps

File: e\_SECAR\_p1\_COSY.lpp

Upload linked COSY matrices

L I S E ++ [G:\SECAR\SECAR\_phase1\_COSY\_o5.lpp]  
18-08-2015 11:31:59

Block	Name	Number of Lines / Status	Filename
Drift	"Q1"	242	G:\SECAR\Q01.TXT
Drift	"Q2"	193	G:\SECAR\Q02.TXT
Dipole	"B1"	252	G:\SECAR\B01.TXT
Dipole	"B2"	252	G:\SECAR\B02.TXT
Drift	"Hex1"	208	G:\SECAR\H01.TXT
Drift	"Q3"	194	G:\SECAR\Q03.TXT
Drift	"Q4"	194	G:\SECAR\Q04.TXT
Drift	"Q5"	193	G:\SECAR\Q05.TXT
Dipole	"B3"	252	G:\SECAR\B03.TXT
Dipole	"B4"	252	G:\SECAR\B04.TXT
Drift	"Hex2"	211	G:\SECAR\H02.TXT
Drift	"Q6"	192	G:\SECAR\Q06.TXT
Drift	"Q7"	186	G:\SECAR\Q07.TXT
Wien	"VF1"	247	G:\SECAR\VF1.TXT
Drift	"Hex3"	220	G:\SECAR\H03.TXT
Drift	"Oct1"	148	G:\SECAR\OCT1.TXT
Drift	"Q12"	193	G:\SECAR\Q12.TXT
Drift	"Q13"	194	G:\SECAR\Q13.TXT
Dipole	"B7"	252	G:\SECAR\B07.TXT
Dipole	"B8"	252	G:\SECAR\B08.TXT
Drift	"Q14"	193	G:\SECAR\Q14.TXT
Drift	"Q15"	193	G:\SECAR\Q15.TXT

Number of links: 22      Number of good links: 22

“SECAR v6s.fox” can be used to generate these “local “maps

```

UM;
MC RADIUS 22.5 0.030 B1N B1S1 B1S2 7;           {B1}
PM_LISE 'B01.TXT' ;

DL 1.0000 ;                                     {DL4}

UM;
MC RADIUS 22.5 0.030 B1N B2S1 B2S2 7;           {B2}
PM_LISE 'B02.TXT' ;

DL 0.7700 ;                                     {DL5}
DL 0.4000 ;                                     {DL6}

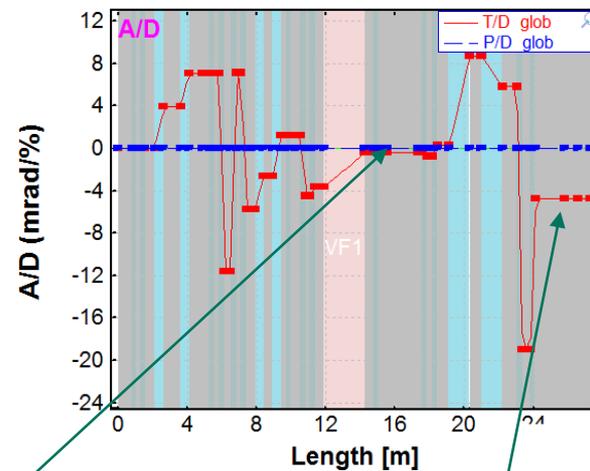
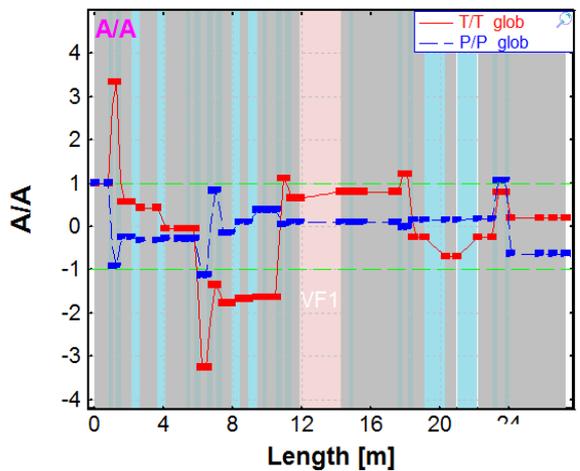
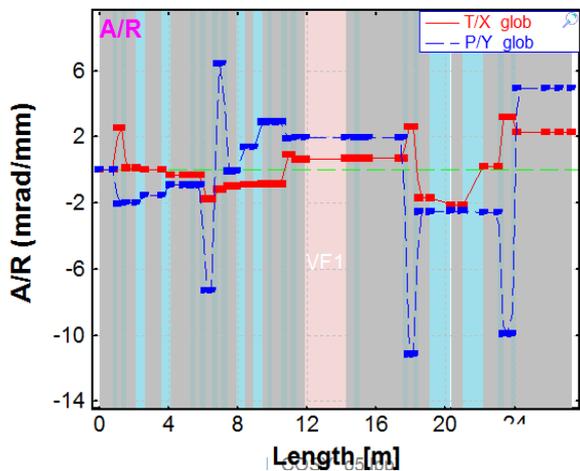
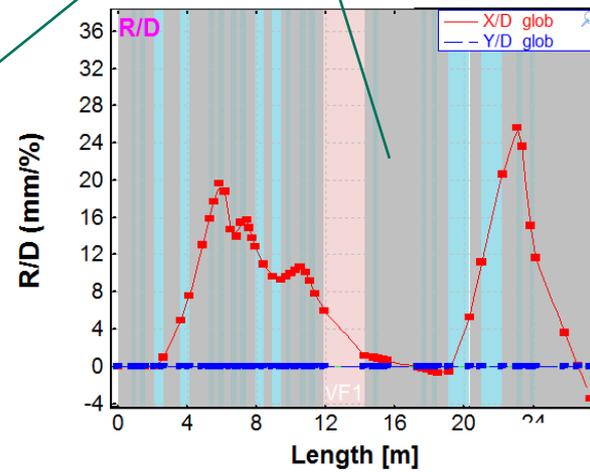
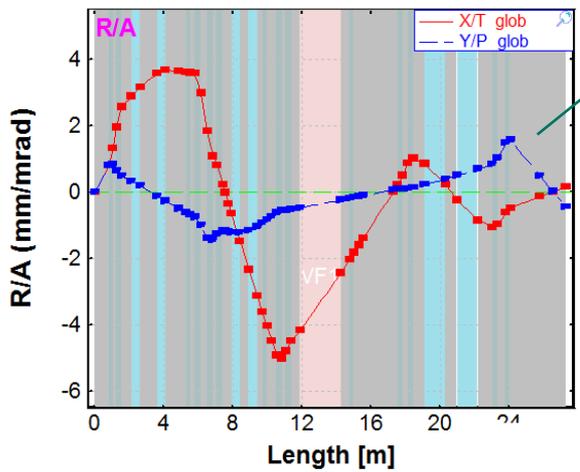
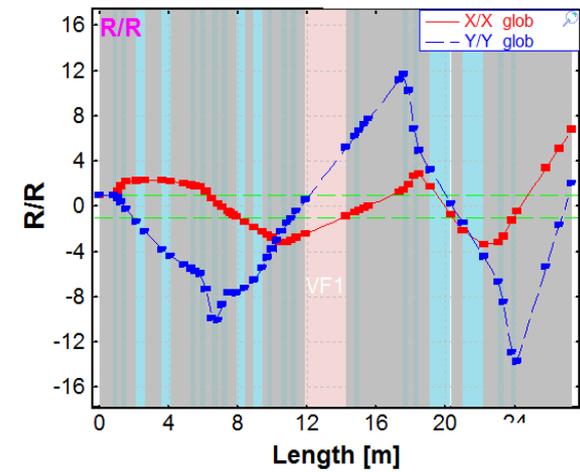
UM;
MH 0.2600 0.008620 0.11;                       {HEX1}
PM_LISE 'H01.TXT' ;
    
```

File: e\_SECAR\_phase1\_COSY\_o5.lpp

Will be zoomed on the next page

## First order matrix elements

<sup>66</sup>Se (3.1 MeV/u); Settings on <sup>66</sup>Se<sup>21+..21+</sup>; Config: DSSSSDSDSSSSSSSSSSSSSSSDSDS..  
 dp/p=14.49% ; Brho(Tm): 0.8000, 0.8000, 0.8000, 0.8000, 0.8000....



Almost zero angular dispersion

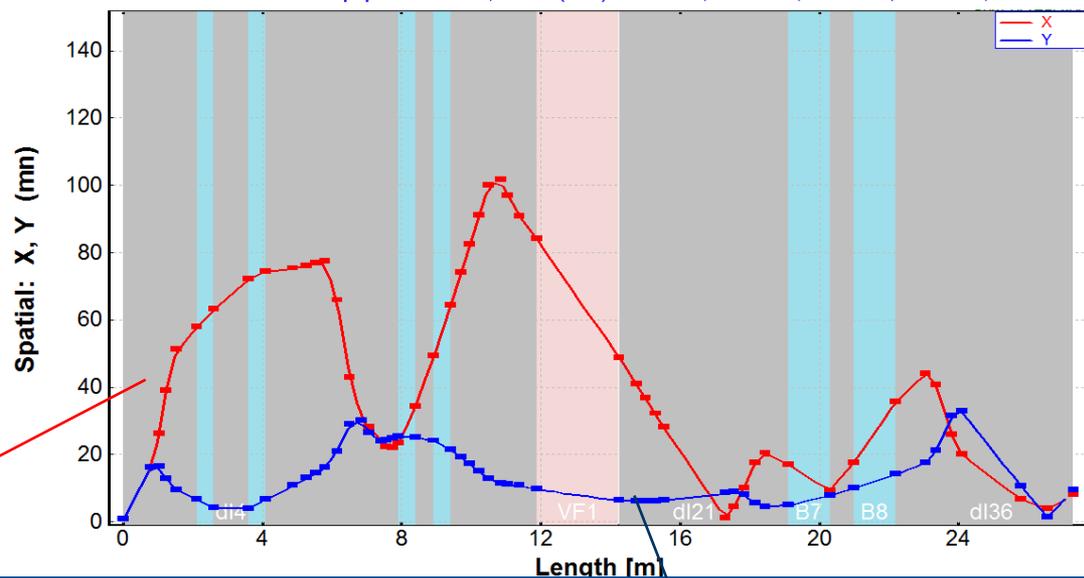
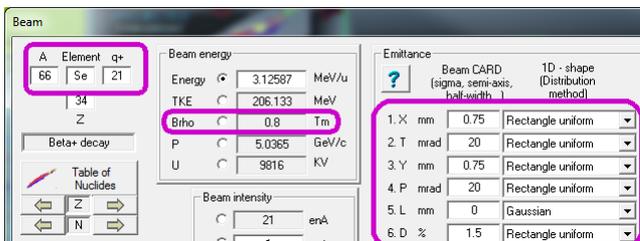
Non-zero angular dispersion



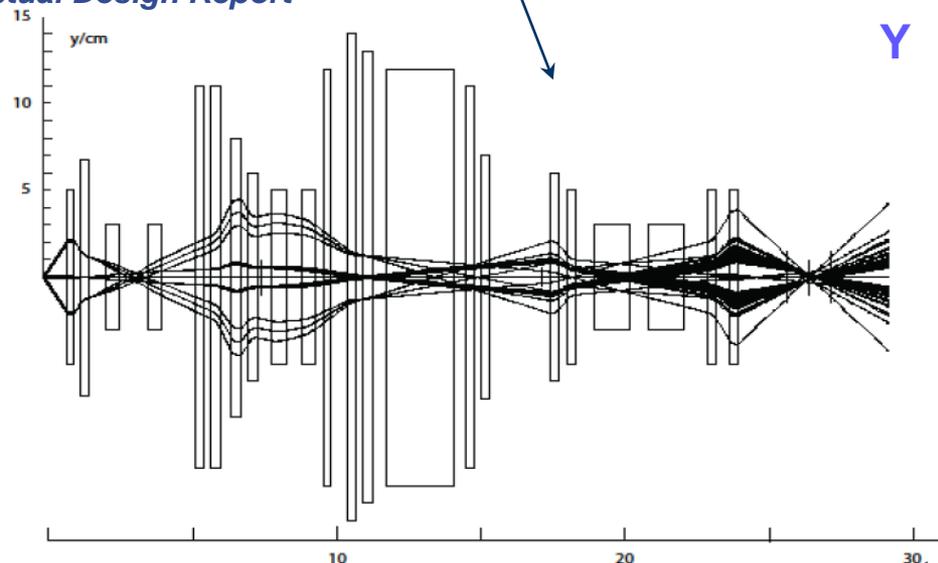
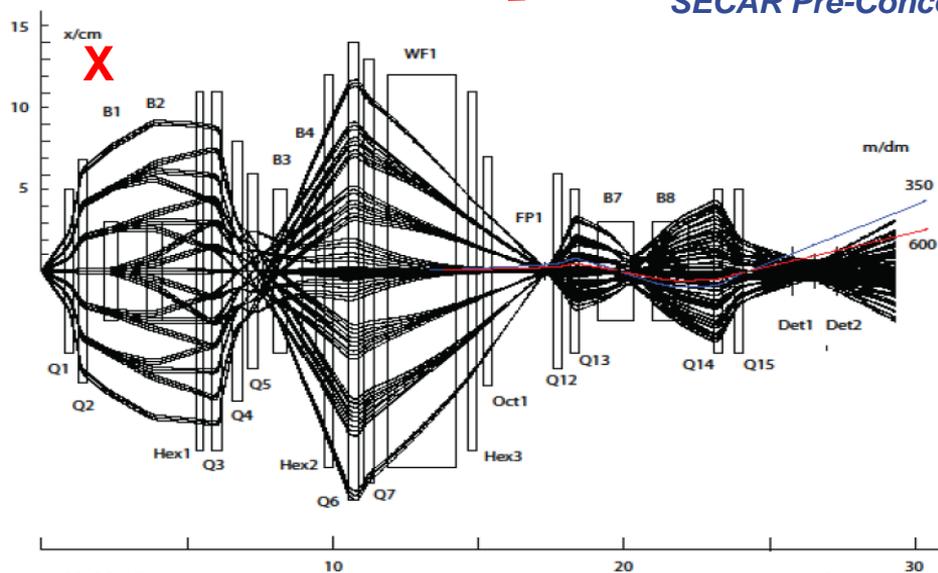
File: e\_SECAR\_phase1\_COSY\_o5.lpp

## Beam Sigmas: spatial

$^{66}\text{Se}$  (3.1 MeV/u); Settings on  $^{66}\text{Se}^{21+}$ ; Config: DSSSSSDSDSSSSSSSSSS  
 $dp/p=14.49\%$ ; Brho(Tm): 0.8000, 0.8000, 0.8000, 0.8000, 0.8000..



## SECAR Pre-Conceptual Design Report



File: e\_SECAR\_phase1\_COSY\_o5.lpp

Beam configuration parameters:

Element	66	Se	21
Z	34		
Beam energy	3.12587	MeV/u	
TKE	206.133	MeV	
Brho	0.9	Tm	
P	5.0365	GeV/c	
U	9816	KV	
Beam intensity	21	nA	
	1	nA	

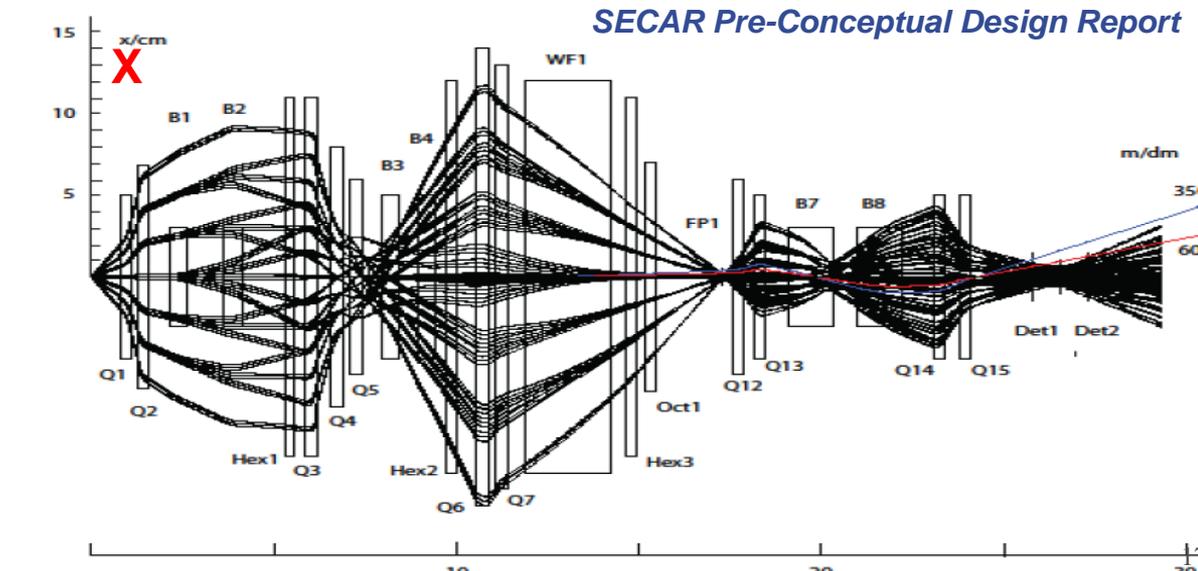
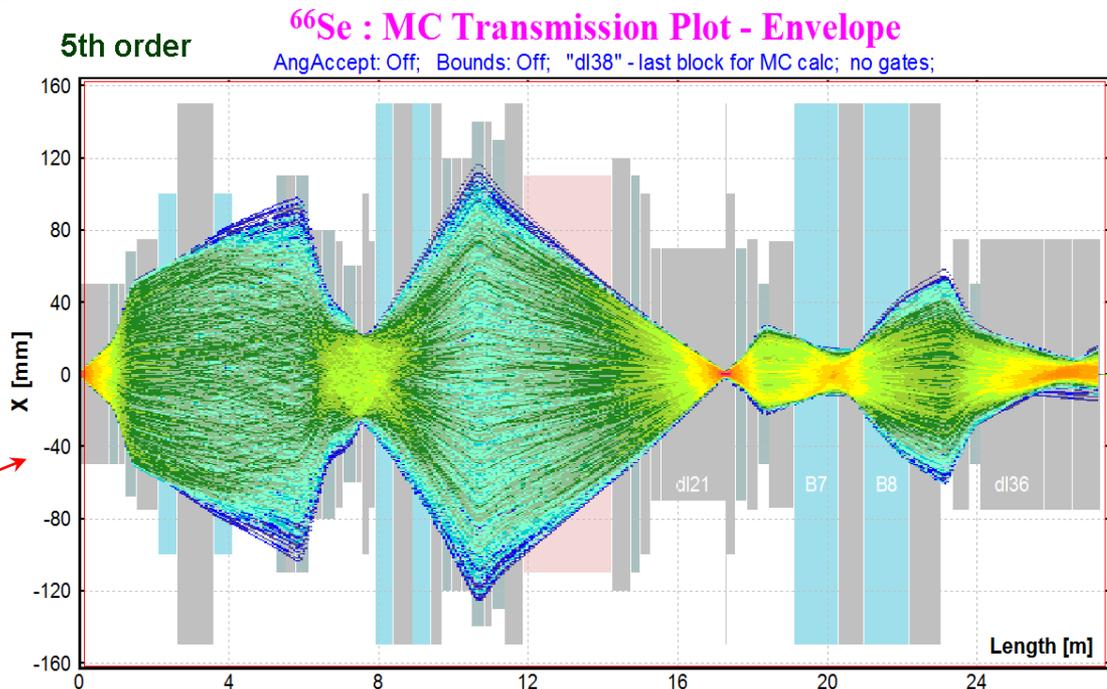
Enittance parameters:

1. X mm	0.75	Rectangle uniform
2. T mrad	20	Rectangle uniform
3. Y mm	0.75	Rectangle uniform
4. P mrad	20	Rectangle uniform
5. L mm	0	Gaussian
6. D %	1.5	Rectangle uniform



Monte Carlo calculation of fragment transmission options:

- What isotope transmission to calculate?
  - One fragment of interest. Chose manually here
  - Group of isotopes already calculated by the Distribution method (Ncalc = 0)
  - List of isotopes from file to produce inside target
  - Input ions rays from file emitted from target
- Chose fragment of interest:
  - A: 66, Element: Se, Z: 34
  - Reaction mechanism: Projectile Fragmentation
  - MC transmission options: 5/07
- X-coordinate: d38
- Y-coordinate: d38
- Envelope calculation:  Envelope



File: e\_SECAR\_phase1\_COSY\_o5.lpp

Beam configuration parameters:

Element	q+
66	Se
34	Z
21	Z

Beam energy:

Energy	3.12587 MeV/u
TKE	206.133 MeV
Brho	0.8 Tm
P	5.0365 GeV/c
U	9816 KV

Enittance:

1. X mm	0.75	Rectangle uniform
2. T mrad	20	Rectangle uniform
3. Y mm	0.75	Rectangle uniform
4. P mrad	20	Rectangle uniform
5. L mm	0	Gaussian
6. D %	1.5	Rectangle uniform

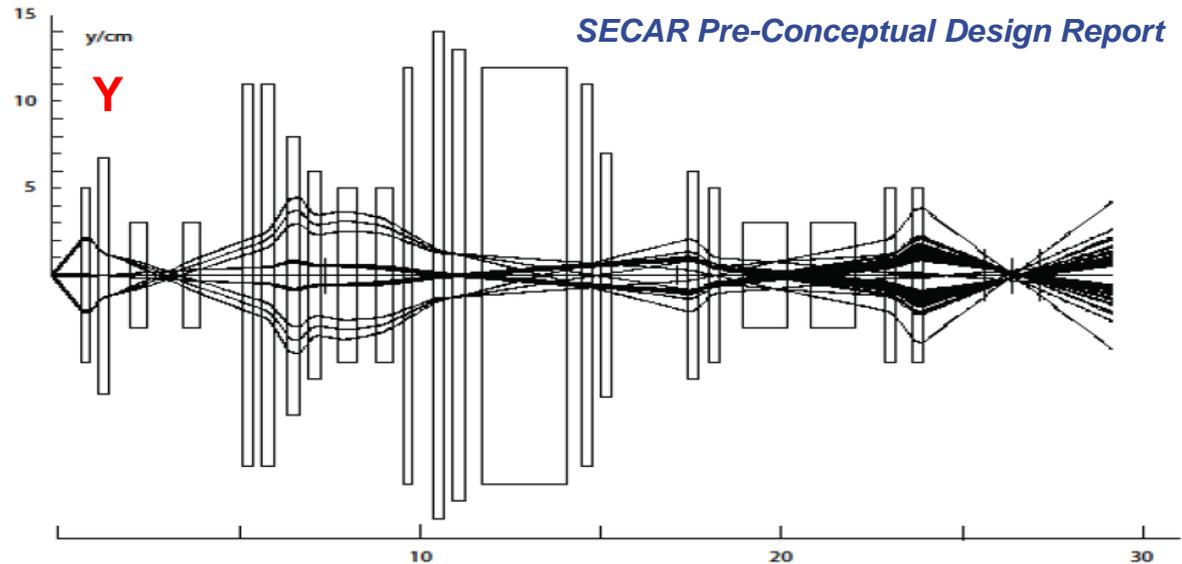
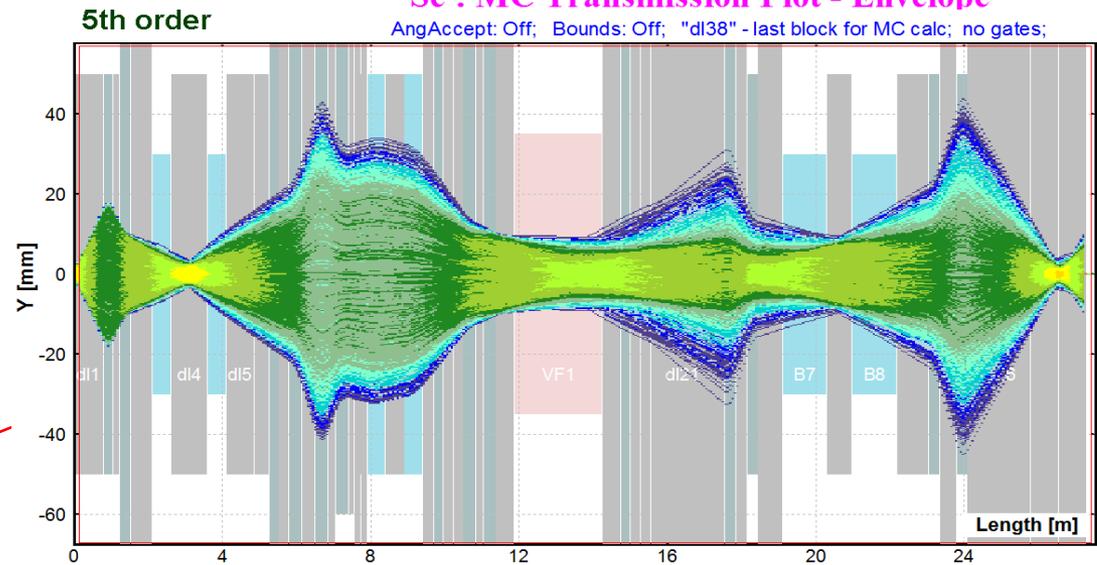
Beam CARD (sigma, semi-axis, half-length)

1D - shape (Distribution method)



## <sup>66</sup>Se : MC Transmission Plot - Envelope

AngAccept: Off; Bounds: Off; "dl38" - last block for MC calc; no gates;

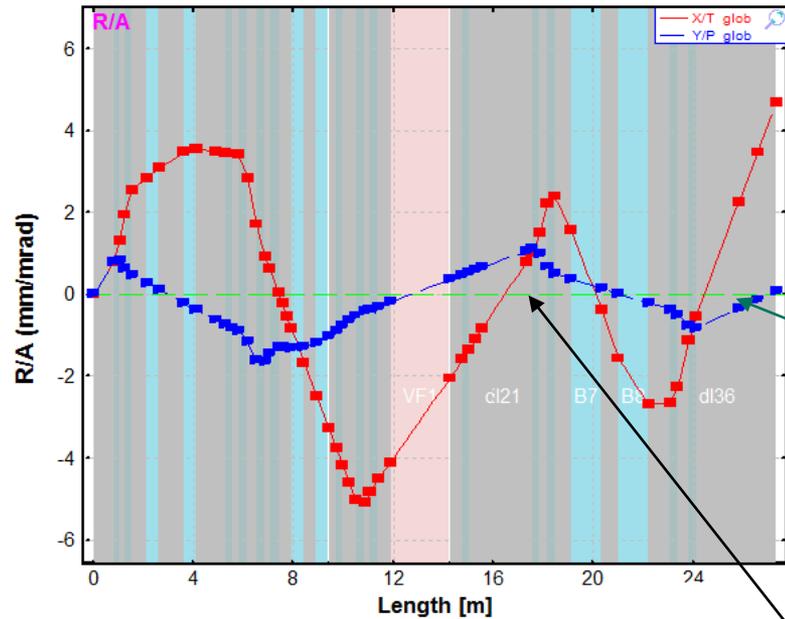


File: e\_SECAR\_phase1.lpp

Using fields from the SECAR Pre-Conceptual Design Report

## First order matrix elements

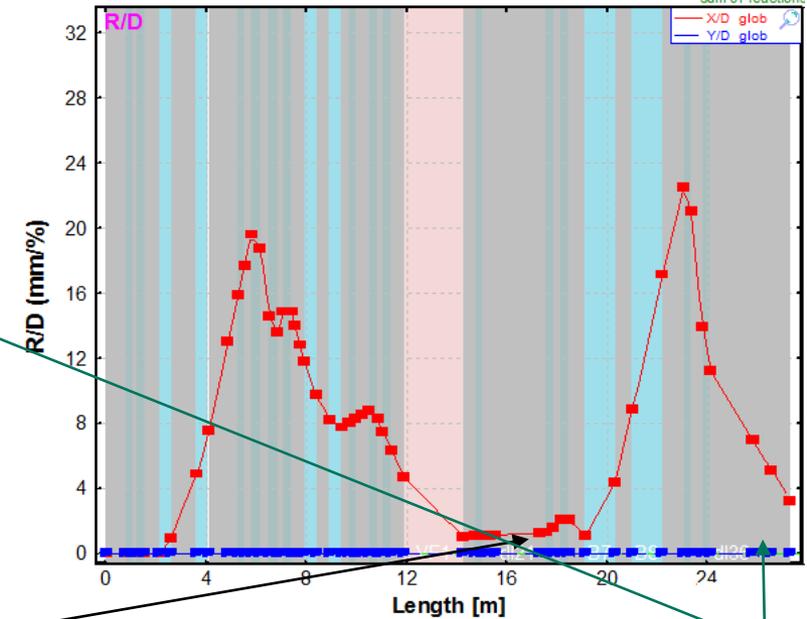
<sup>66</sup>Se (3.1 MeV/u) + Be (1e-3 mg/cm<sup>2</sup>); Settings on <sup>66</sup>Se<sup>21+,21+</sup>; Config: DSSFSSFSFDSDFFSSSFSSSFSSF...  
 dp/p=15.59% ; Brho(Tm): 0.8000, 0.8000, 0.8000, 0.8000, 0.8000....



FP2 – no double focus, small dispersion

Global matrix

1.71399	0.7896	0	0	0	1.27182	[mm]
0.75758	0.93241	0	0	0	0.08012	[mrad]
0	0	15.94788	1.06042	0	0	[mm]
0	0	2.52905	0.23087	0	0	[mrad]
-0.4117	-0.9308	0	0	1	-9.86959	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	



DL37 – no X-focus, small dispersion

Global matrix

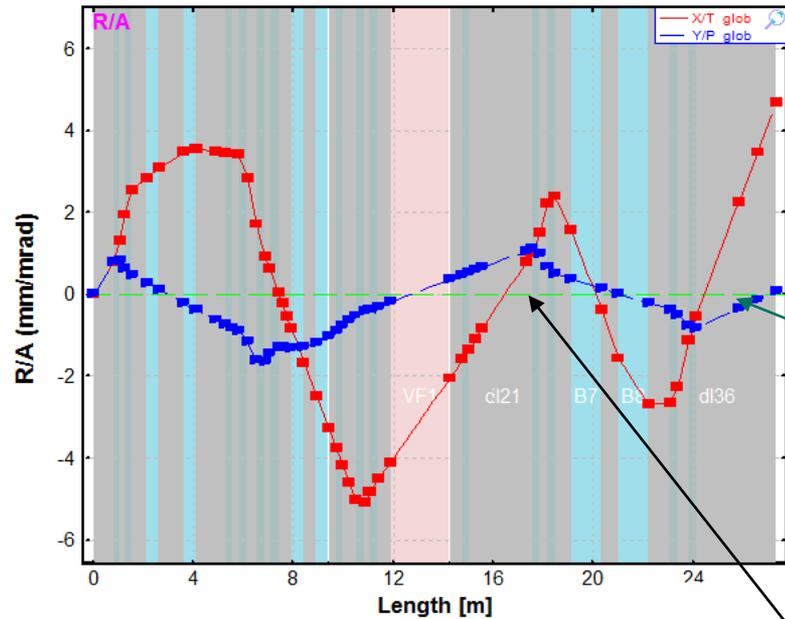
7.39269	3.46894	0	0	0	5.11233	[mm]
3.19314	1.6336	0	0	0	-2.49489	[mrad]
0	0	-1.96752	-0.13856	0	0	[mm]
0	0	11.19827	0.28033	0	0	[mrad]
2.98263	0.65761	0	0	1	-24.18632	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	

File: e\_SECAR\_phase1.lpp

Using fields from the SECAR Pre-Conceptual Design Report

## First order matrix elements

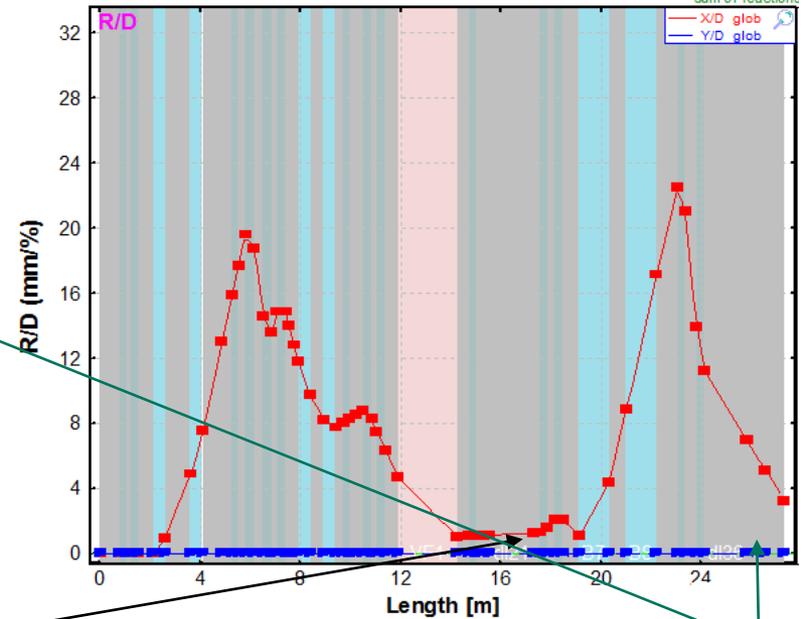
<sup>66</sup>Se (3.1 MeV/u) + Be (1e-3 mg/cm<sup>2</sup>); Settings on <sup>66</sup>Se<sup>21+,21+</sup>; Config: DSSFSSFSFDSDFFSSSFSSSFSSF...  
 dp/p=15.59% ; Brho(Tm): 0.8000, 0.8000, 0.8000, 0.8000, 0.8000....



FP2 – no double focus, small dispersion

Global matrix

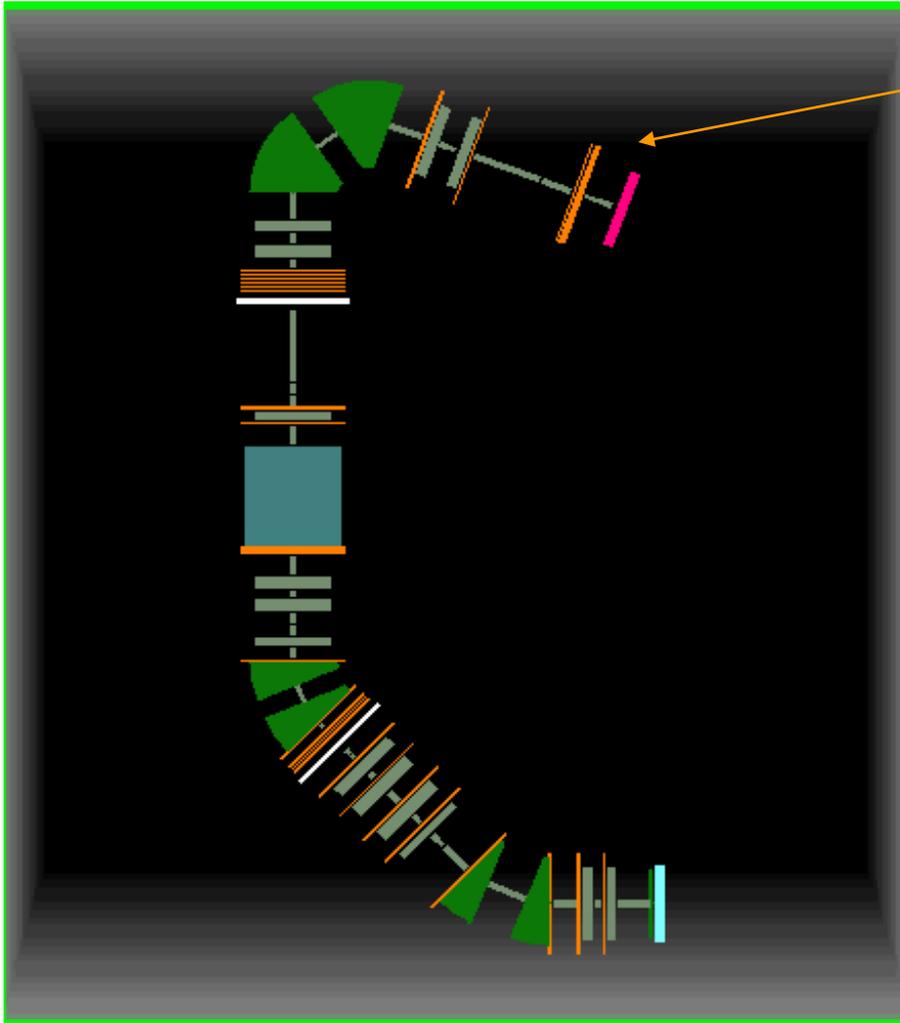
1.71399	0.7896	0	0	0	1.27182	[mm]
0.75758	0.93241	0	0	0	0.08012	[mrad]
0	0	15.94788	1.06042	0	0	[mm]
0	0	2.52905	0.23087	0	0	[mrad]
-0.4117	-0.9308	0	0	1	-9.86959	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	



DL37 – no X-focus, small dispersion

Global matrix

7.39269	3.46894	0	0	0	5.11233	[mm]
3.19314	1.6336	0	0	0	-2.49489	[mrad]
0	0	-1.96752	-0.13856	0	0	[mm]
0	0	11.19827	0.28033	0	0	[mrad]
2.98263	0.65761	0	0	1	-24.18632	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	



28 constraints,  
11 variable fields

Optics fit

Blocks with parameters to vary	Active Constraint blocks
#01-q Position@005: Q1	#12 @036: sY < 50 B3_sY
#02-q Position@008: Q2	#13 @040: sY < 50 B4_sY
#03-q Position@021: Q3	#14 @049: sX < 110 VF1_sX
#04-q Position@024: Q4	#15 @050: sY < 35 VF1_sY
#05-q Position@027: Q5	#16 @053: sY < 80 Hex3_sY
#06-q Position@045: Q6	#17 @055: sX < 80 Hex3_sX
#07-q Position@047: Q7	#18 @060: R16 = 0 FP2_XD
#08-q Position@067: Q12	#19 @061: R26 = 0 FP2_TD
#09-q Position@069: Q13	#20 @062: R12 = 0 FP2_XT
#10-q Position@076: Q14	#21 @063: R33 < 12 FP2_YYp
#11-q Position@078: Q15	#22 @064: R33 > -11 FP2_YYm
	#23 @065: R34 = 0 FP2_YP
	#24 @075: s R < 50 Q14_sR
	#25 @079: s R < 50 Q15_sR
	#26 @082: R12 = 0 FP_XT
	#27 @083: R34 = 0 FP_YP
	#28 @084: R16 = 0 FP_XD

N iter = 20000

SECAR\_phase1\_v7\_original.fit

Initial **+87.6086** and Final **+0.0023725** LISE fit reduced values

Parameters:	LeftBound	Initial	RightBound	Final
#01-q: Q1	-5.0e+00 <	-3.653e+00 <	+0.0e+00	-3.426e+00
#02-q: Q2	+0.0e+00 <	+2.179e+00 <	+5.0e+00	+1.754e+00
#03-q: Q3	-5.0e+00 <	+2.426e+00 <	+5.0e+00	+2.387e+00
#04-q: Q4	-5.0e+00 <	-2.450e+00 <	+0.0e+00	-2.424e+00
#05-q: Q5	+0.0e+00 <	+1.113e+00 <	+5.0e+00	+1.148e+00
#06-q: Q6	+0.0e+00 <	+1.817e+00 <	+5.0e+00	+1.835e+00
#07-q: Q7	-5.0e+00 <	-3.015e-01 <	+5.0e+00	-2.694e-01
#08-q: Q12	-5.0e+00 <	-2.200e+00 <	+0.0e+00	-2.202e+00
#09-q: Q13	+0.0e+00 <	+2.016e+00 <	+5.0e+00	+1.996e+00
#10-q: Q14	+0.0e+00 <	+1.315e+00 <	+5.0e+00	+1.310e+00
#11-q: Q15	-5.0e+00 <	-1.450e+00 <	+0.0e+00	-1.445e+00

Constant values:	Initial	Final	Precision	(Fin-Des)/P	Desired	(Init-Des)/P
#01: Q1_sX	+2.892e+01	+2.595e+01	1.0e-01	0	< 50	0
#02: Q2_sX	+5.580e+01	+5.056e+01	1.0e+00	0	< 68	0
#03: B1_sY	+6.303e+00	+7.172e+00	1.0e-01	0	< 30	0
#04: B2_sY	+9.241e+00	+6.603e+00	1.0e-03	0	< 30	0
#05: Hex1_sR	+8.225e+01	+1.019e+02	1.0e-01	+2.962e-06	< 110	0
#06: Q3_sX	+6.824e+01	+8.835e+01	1.0e+00	0	< 100	0
#07: Q4_sX	+2.884e+01	+4.068e+01	1.0e+00	0	< 80	0
#08: Q5_sX	+2.233e+01	+2.764e+01	1.0e+00	0	< 60	0
#09: FP1_12	-5.378e-01	+2.724e-09	1.0e-03	+2.724e-06	= 0	<b>+5.378e+02</b>
#10: FP1_sX	-2.260e+01	+1.961e+01	1.0e-01	+3.069e-07	< 30	<b>+6.108e-06</b>
#11: FP1_VY	-7.488e+00	-7.062e+00	1.0e-01	+5.299e-04	> -10	<b>+8.113e-04</b>
#12: B3_sY	+2.959e+01	+2.585e+01	1.0e+00	0	< 50	0
#13: B4_sY	+2.283e+01	+2.198e+01	1.0e+00	0	< 50	0
#14: UF1_sX	+9.055e+01	+1.061e+02	1.0e-02	+1.975e-03	< 110	0
#15: UF1_sY	+4.503e+00	+1.018e+01	1.0e+00	0	< 35	0
#16: Hex3_sX	+1.259e+01	+6.543e+00	1.0e+00	0	< 80	0
#17: Hex3_sY	+2.965e+01	+4.664e+01	1.0e+00	0	< 80	0
#18: FP2_XD	+1.272e+00	+3.472e-09	1.0e-03	+3.472e-06	= 0	<b>+1.272e+03</b>
#19: FP2_ID	+8.022e-02	+4.284e-07	1.0e-01	+4.284e-06	= 0	<b>+8.022e-01</b>
#20: FP2_XT	+7.895e-01	+5.695e-10	1.0e-03	+5.695e-07	= 0	<b>+7.895e+02</b>
#21: FP2_VYp	+1.595e+01	+1.066e+01	1.0e+00	+2.607e-04	< 12	<b>+3.950e+00</b>
#22: FP2_VYm	+1.595e+01	+1.066e+01	1.0e+00	0	> -11	0
#23: FP2_YP	+1.061e+00	+2.490e-06	1.0e-01	+2.490e-05	= 0	<b>+1.061e+01</b>
#24: Q14_sR	+6.911e+01	+4.977e+01	1.0e-01	+7.938e-03	< 50	<b>+1.911e+02</b>
#25: Q15_sR	+3.518e+01	+4.173e+01	1.0e-01	+2.568e-06	< 50	0
#26: FP_XT	+3.469e+00	-5.178e-09	1.0e-02	+5.178e-07	= 0	<b>+3.469e+02</b>
#27: FP_YP	-1.386e-01	-3.576e-07	1.0e-01	+3.576e-06	= 0	<b>+1.386e+00</b>
#28: FP_XD	+5.115e+00	+1.264e-08	1.0e-01	+1.264e-07	= 0	<b>+5.115e+01</b>

finally all constraints were positively done!!!

## RESULTS

FP1

Global matrix

-0.42355	0	0	0	0	13.07058	[mm]
-1.4315	-2.36101	0	0	0	-6.50724	[mrad]
0	0	-7.06243	-1.24098	0	0	[mm]
0	0	-0.00062	-0.1417	0	0	[mrad]
-2.14666	-3.08598	0	0	1	-2.54049	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	

FP2

Global matrix

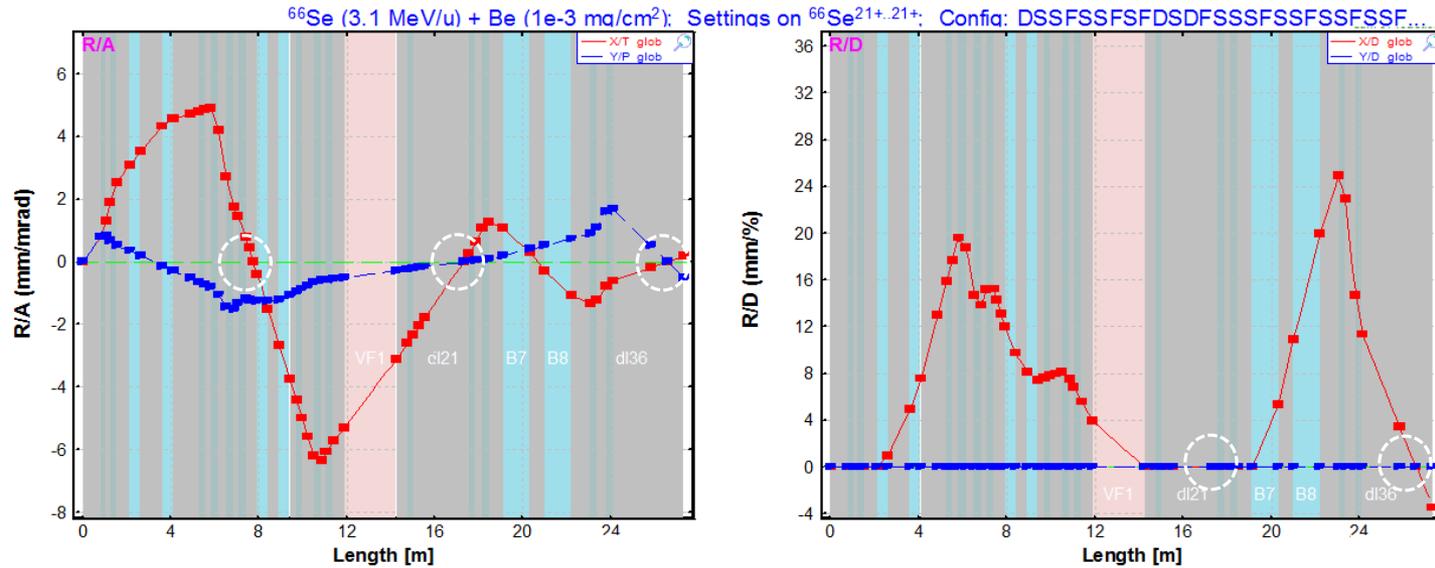
0.98207	0	0	0	0	0	[mm]
0.81236	1.01825	0	0	0	0	[mrad]
0	0	10.65564	0	0	0	[mm]
0	0	1.84593	0.09385	0	0	[mrad]
-0.81191	-1.42307	0	0	1	-9.82722	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	

DL37

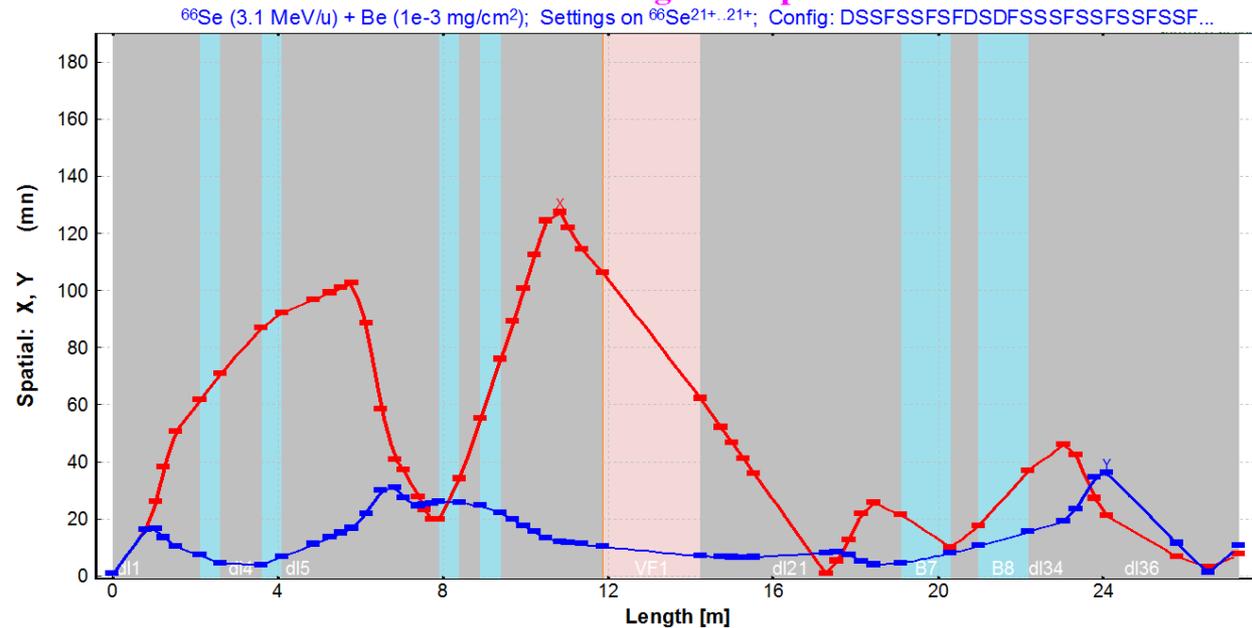
Global matrix

4.03844	0	0	0	0	0.00001	[mm]
1.85669	0.24762	0	0	0	-4.63011	[mrad]
0	0	-1.46124	0	0	0	[mm]
0	0	6.71082	-0.68434	0	0	[mrad]
1.05793	-1.42307	0	0	1	-26.6422	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	

## First order matrix elements



## Beam Sigmas: spatial



element	Initial	LISE <sup>++</sup> result	delta
Q1	-3.6534	-3.4260	0.2274
Q2	2.1788	1.7540	-0.4248
Q3	2.4264	2.3870	-0.0394
Q4	-2.4501	-2.4240	0.0261
Q5	1.1128	1.1480	0.0352
Q6	1.8172	1.8350	0.0178
Q7	-0.3015	-0.2694	0.0321
Q12	-2.2000	-2.2020	-0.0020
Q13	2.0160	1.9960	-0.0200
Q14	1.3147	1.3100	-0.0047
Q15	-1.4500	-1.4450	0.0050

See details for angular acceptance with the next link [http://lise.nsl.msui.edu/9\\_8/SE\\_blocks.pdf#page=5](http://lise.nsl.msui.edu/9_8/SE_blocks.pdf#page=5)

## Settings

Beam dialog

Emittance	Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)	2D mode
1. X mm	0.1	Gaussian	<input type="checkbox"/>
2. T mrad	50	Rectangle uniform	<input type="checkbox"/>
3. Y mm	0.1	Gaussian	<input type="checkbox"/>
4. P mrad	60	Rectangle uniform	<input type="checkbox"/>
5. L mm	0	Gaussian	<input type="checkbox"/>
6. D %	0.01	Rectangle uniform	<input type="checkbox"/>

Monte Carlo options

Angular Acceptance & Bounds

Use fixed angular acceptances

Use physical limits (aperture) inside blocks to calculate fragment transmission

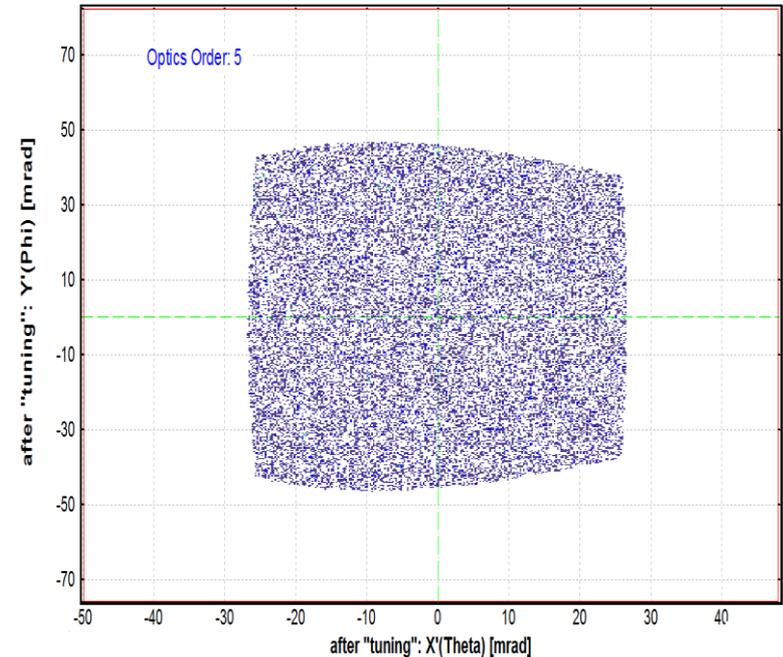
For block apertures LISE++ uses the slit limits accessible from the Block Cut & Acceptance dialog. (Pay attention there for the checkbox)

Monte Carlo Transmission settings

## Coming to the FP1

### <sup>66</sup>Se : Monte Carlo Transmission Plot

AngAccept: Off; Bounds: ON; "dl11" - last block for MC calc; Gate 1: "AND" (X [mm]);



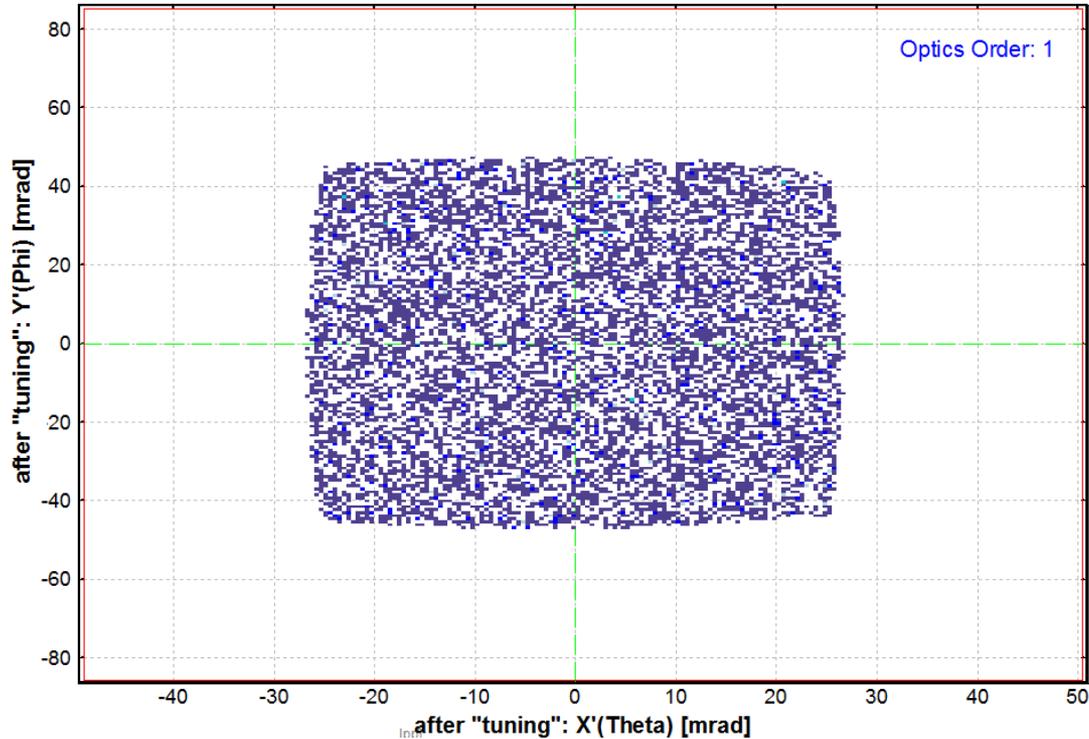
### Angular acceptance "Target - FP1"

	5th order	
X'	26.4	mrad
Y'	43.4	mrad

## <sup>66</sup>Se : Monte Carlo Transmission Plot

<sup>66</sup>Se (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Transmitted Fragment <sup>66</sup>Se<sup>21+..21+</sup> (beam);  
 dp/p=100.00% ; Brho(Tm): 0.7988, 0.7988, 0.7988

AngAccept: Off; Bounds: ON; "d111" - last block for MC calc; Gate 1: "AND" (X [mm]);

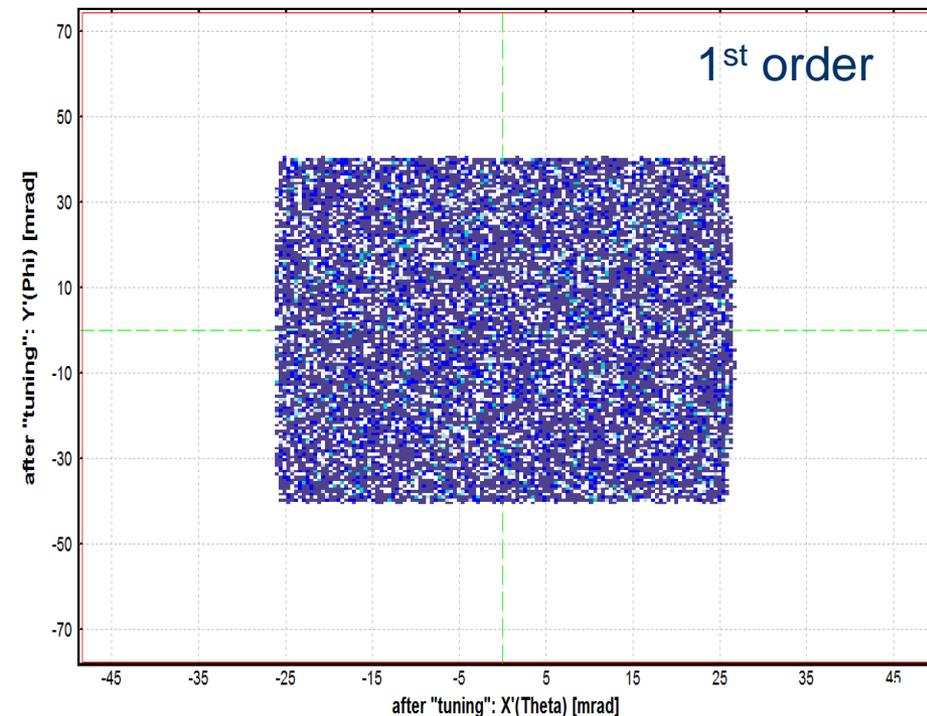


Angular acceptance "Target - FP1"		
	1st order	
X'	26.3	mrad
Y'	45.8	mrad

## <sup>66</sup>Se : Monte Carlo Transmission Plot

<sup>66</sup>Se (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Transmitted Fragment <sup>66</sup>Se<sup>21+.21+</sup> (beam); Optics Order: 1  
 dp/p=14.49% ; Brho(Tm): 0.7988, 0.7988, 0.7988, 0.7988, 0.7988....

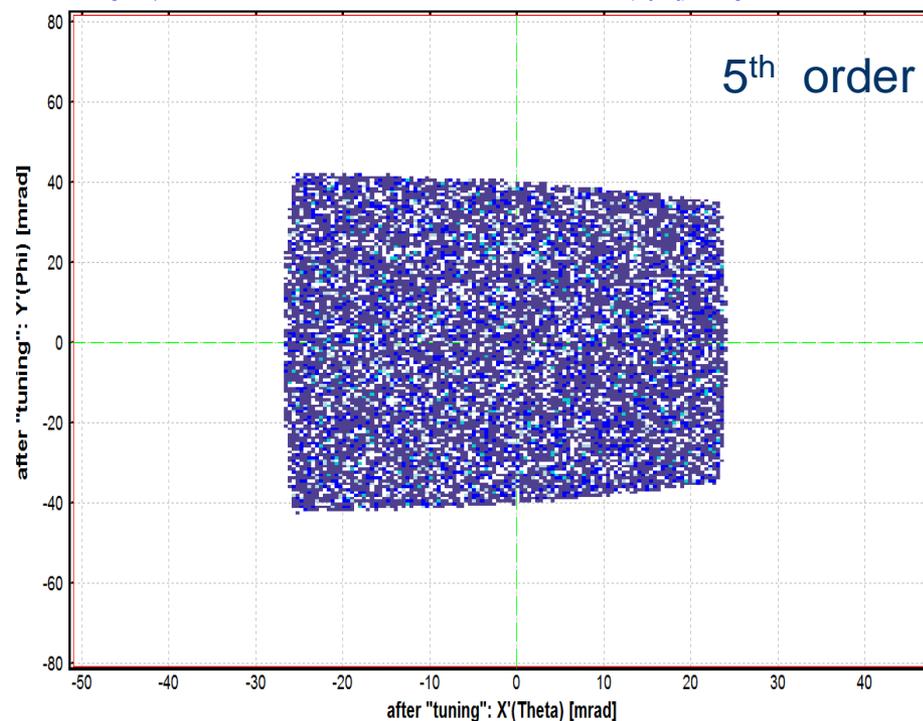
AngAccept: Off; Bounds: ON; "dl21" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSDSDSSSSSSSSSS



## <sup>66</sup>Se : Monte Carlo Transmission Plot

<sup>66</sup>Se (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Transmitted Fragment <sup>66</sup>Se<sup>21+.21+</sup> (beam); Optics Order: 5  
 dp/p=14.49% ; Brho(Tm): 0.7988, 0.7988, 0.7988, 0.7988, 0.7988....

AngAccept: Off; Bounds: ON; "dl21" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSDSDSSSSSSSSSS



### Angular acceptance "Target - FP2"

	1st order	
X'	26.4	mrad
Y'	40.6	mrad

### Angular acceptance "Target - FP2"

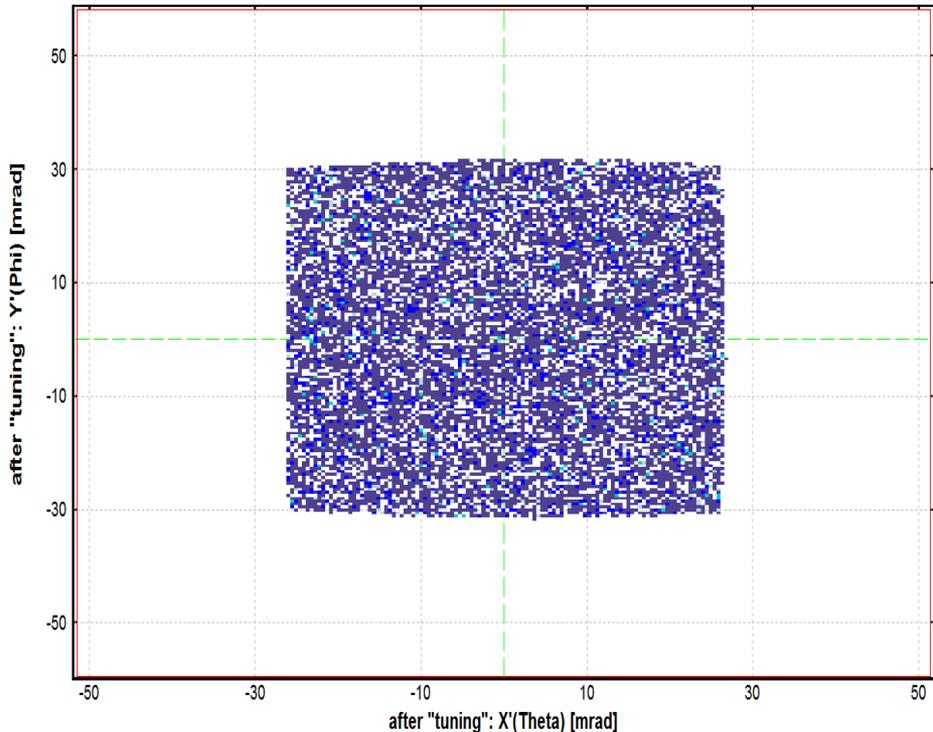
	5th order	
X'	25.2	mrad
Y'	39.8	mrad

# SECAR phase1 Angular Acceptance: Target – DL37

## <sup>66</sup>Se : Monte Carlo Transmission Plot

<sup>66</sup>Se (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Transmitted Fragment <sup>66</sup>Se<sup>21+..21+</sup> (beam); Optics Order: 1  
 dp/p=14.49% ; Brho(Tm): 0.7988, 0.7988, 0.7988, 0.7988, 0.7988....

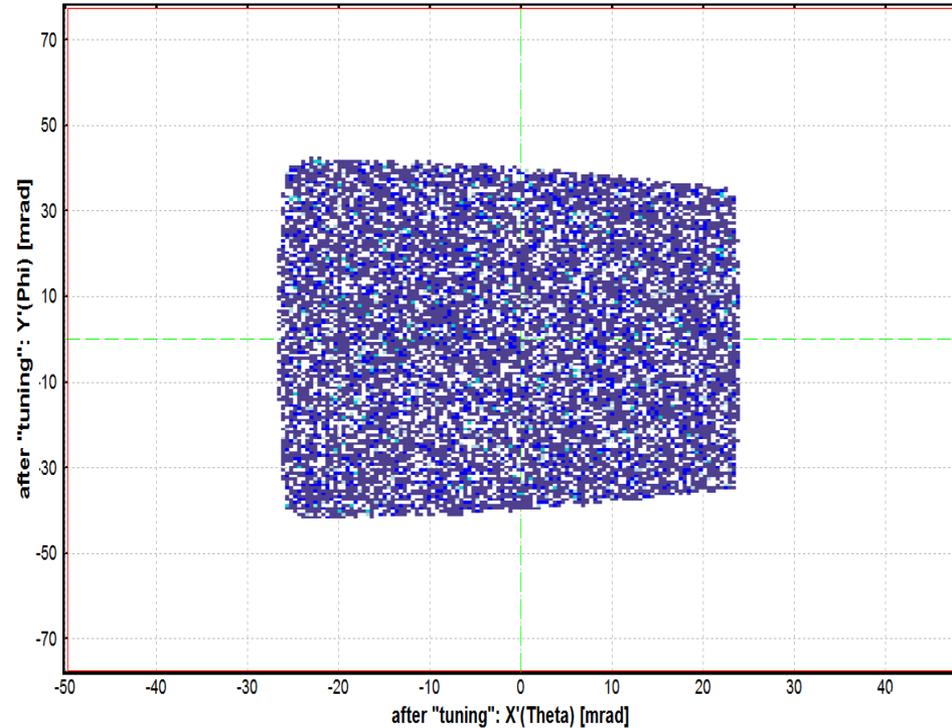
AngAccept: Off; Bounds: ON; "dl37" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSDSDSSSSSSSSSS



## <sup>66</sup>Se : Monte Carlo Transmission Plot

<sup>66</sup>Se (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Transmitted Fragment <sup>66</sup>Se<sup>21+..21+</sup> (beam); Optics Order: 5  
 dp/p=14.49% ; Brho(Tm): 0.7988, 0.7988, 0.7988, 0.7988, 0.7988....

AngAccept: Off; Bounds: ON; "dl37" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSDSDSSSSSSSSSS



Angular acceptance "Target - DL37"		
	1st order	
X'	26.5	mrad
Y'	31.4	mrad

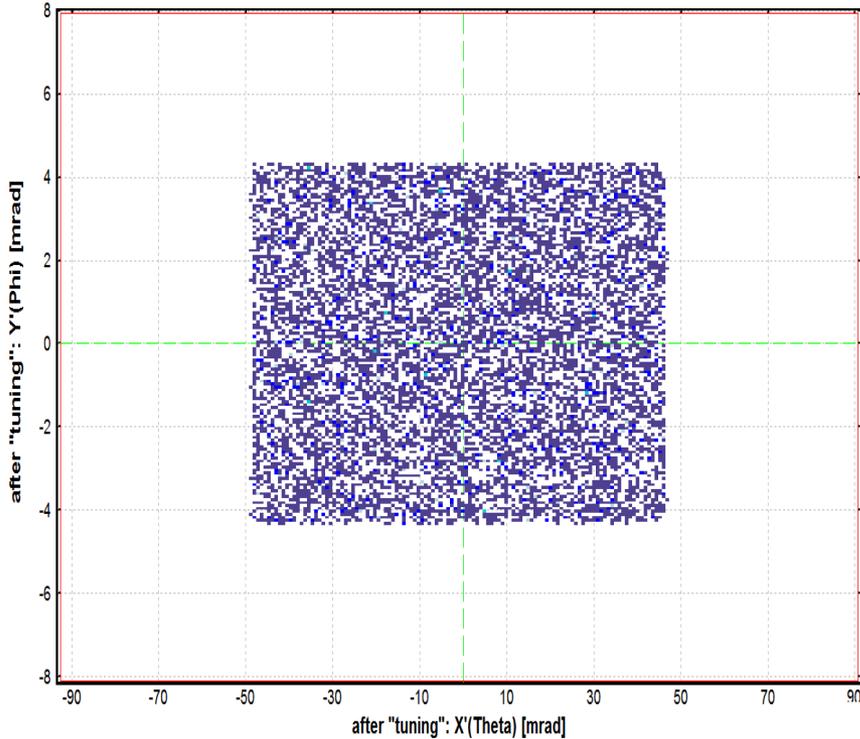
Angular acceptance "Target - DL37"		
	5th order	
X'	25.2	mrad
Y'	40.0	mrad

## FP1 - FP2

### $^{66}\text{Se}$ : Monte Carlo Transmission Plot

$^{66}\text{Se}$  (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Transmitted Fragment  $^{66}\text{Se}^{21+,21+}$  (beam); Optics Order: 1  
 dp/p=9.11% ; Brho(Tm): 0.7988, 0.7988, 0.7988, 0.7988

AngAccept: Off; Bounds: ON; "dl21" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSDSDSSSSSSSSSSSSSS



	1st order	
X'	47.9	mrad
<del>Y'</del>	<del></del>	<del>mrad</del>

**There is not vertical focus at FP1!**

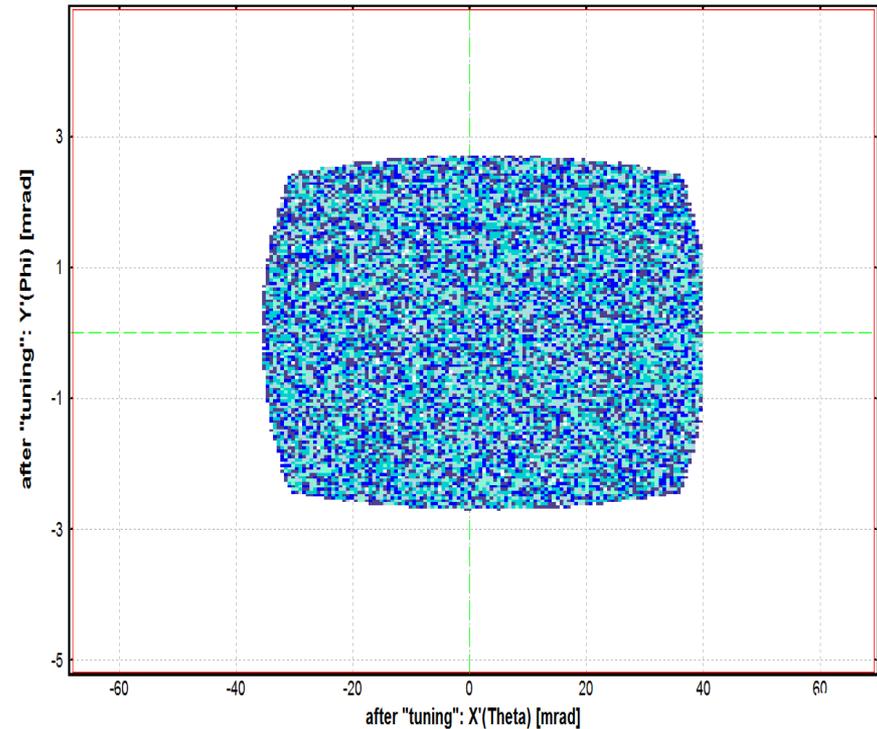
**It is impossible to use vertical angular acceptance here**

## FP2 - DL37

### $^{66}\text{Se}$ : Monte Carlo Transmission Plot

$^{66}\text{Se}$  (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Transmitted Fragment  $^{66}\text{Se}^{21+,21+}$  (beam); Optics Order: 1  
 dp/p=100.00% ; Brho(Tm): 0.7988, 0.7988, 0.7988

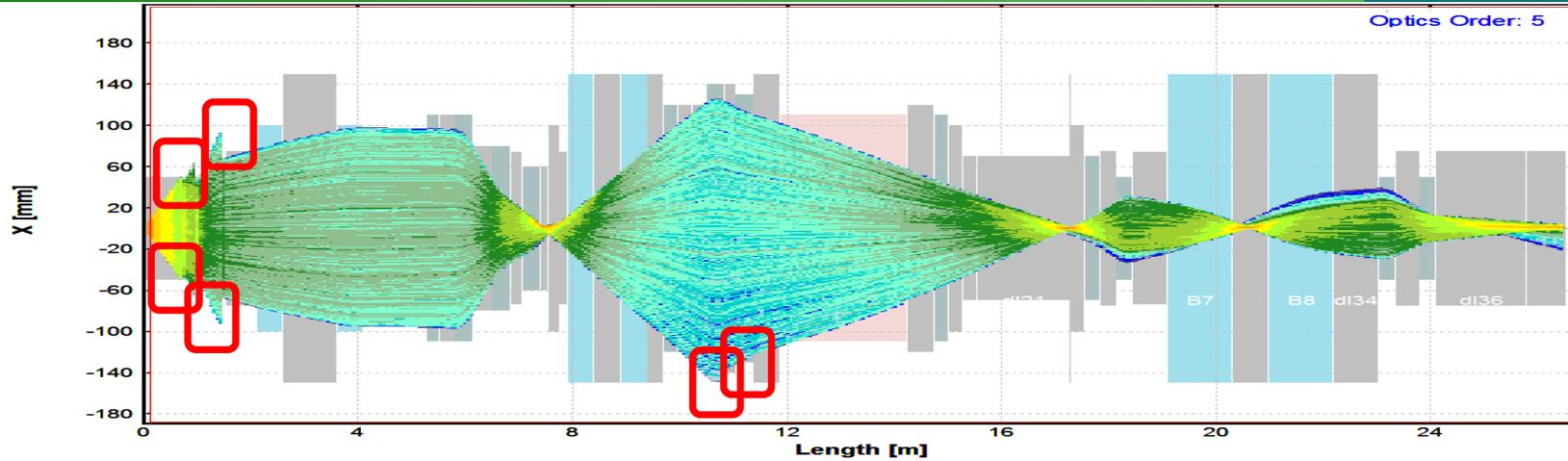
AngAccept: Off; Bounds: ON; "dl37" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSDSDSSSSSS



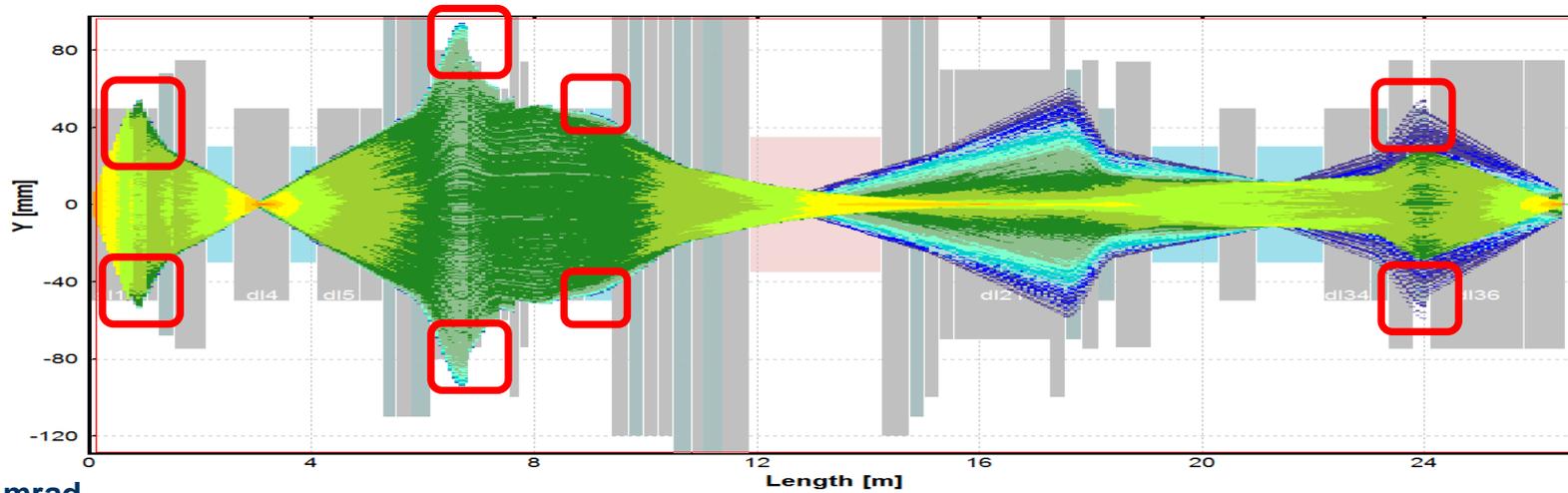
Angular acceptance "FP2 - DL37"		
	1st order	
X'	36.8	mrad
Y'	<b>5.24</b>	mrad

# Angular Emittance Loss (5<sup>th</sup> order optics)

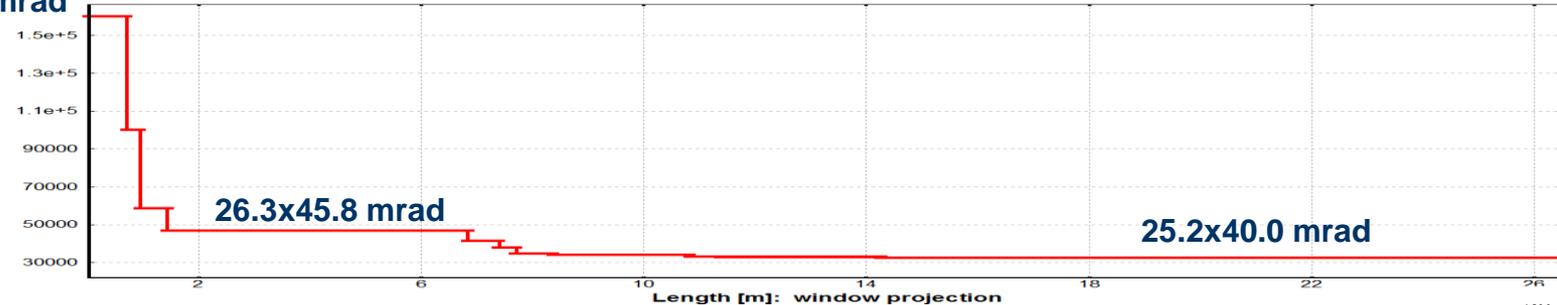
X'



Y'



70x70 mrad



# Angular Acceptances in the SECAR phase1 file

**Angular acceptances used in the SECAR phase1 configurations**

	Target-FP1	FP1 - FP2	FP2 - DL37	
X'	26.3	47.9	36.8	mrاد
Y'	45.8		5.24	mrاد

! FILE: G:\SECAR\SECAR\_phase1\_C001\_05 WITH\_AA.1PP

1 N	2 Block name	3 Kind of Block	4 Start (m)	5 Length (m)	6 DriftMode Angle(")*	7 B0(kG)	8 Br-corrsp Br-dip*	9 Rapp(cm) R(m)*	10 L_eff(m) Len(m)*	11 2nd order	12 Calc Mode	13 AngAcc mode	14 Slits shape
1.	tuning	Dipole	0.000	0.000	+0.0 *	+2.663	0.7988*	3.00*	0.00*	-		HV	rectn
2.	dl1	Drift	0.000	0.800	standard							---	rectn
3.	Q1	Drift	0.800	0.250	multipole	-3.653	0.8000	5.00	0.25	yes	1	---	rectn
4.	dl2	Drift	1.050	0.190	standard							---	rectn
5.	Q2	Drift	1.240	0.300	multipole	+2.179	0.8000	6.80	0.30	yes	1	---	rectn
6.	dl3	Drift	1.540	0.580	standard							---	rectn
7.	B1	Dipole	2.120	0.491	+22.5 *	+6.390	0.7988*	1.25*	0.49*	yes		---	rectn
8.	dl4	Drift	2.611	1.000	standard							---	rectn
9.	B2	Dipole	3.611	0.491	+22.5 *	+6.390	0.7988*	1.25*	0.49*	yes		---	rectn
10.	dl5	Drift	4.102	0.770	standard							---	rectn
11.	dl6	Drift	4.872	0.400	standard							---	rectn
12.	Hex1	Drift	5.272	0.260	multipole	+0.000	0.8000	11.00	0.26	yes	1	---	rectn
13.	dl7	Drift	5.532	0.270	standard							---	rectn
14.	Q3	Drift	5.802	0.350	multipole	+2.426	0.8000	11.00	0.35	yes	1	---	rectn
15.	dl8	Drift	6.152	0.350	standard							---	rectn
16.	Q4	Drift	6.502	0.350	multipole	-2.450	0.8000	8.00	0.35	yes	1	---	rectn
17.	dl9	Drift	6.852	0.210	standard							---	rectn
18.	Q5	Drift	7.062	0.350	multipole	+1.113	0.8000	6.00	0.35	yes	1	---	rectn
19.	dl10	Drift	7.412	0.145	standard							---	rectn
20.	dl11	Drift	7.557	0.185	standard							---	rectn
21.	slits FP1	Drift	7.742	0.000	SLITS							---	rectn
22.	dl12	Drift	7.742	0.170	standard							H-	rectn
23.	B3	Dipole	7.912	0.491	+22.5 *	+6.390	0.7988*	1.25*	0.49*	yes		---	rectn
24.	dl13	Drift	8.403	0.510	standard							---	rectn
25.	B4	Dipole	8.913	0.491	+22.5 *	+6.390	0.7988*	1.25*	0.49*	yes		---	rectn
26.	dl14	Drift	9.403	0.300	standard							---	rectn
27.	Hex2	Drift	9.703	0.260	multipole	+0.000	0.8000	12.00	0.26	yes	1	---	rectn
28.	dl15	Drift	9.963	0.270	standard							---	rectn
29.	dl16	Drift	10.233	0.270	standard							---	rectn
30.	Q6	Drift	10.503	0.340	multipole	+1.817	0.8000	14.00	0.34	yes	1	---	rectn
31.	dl17	Drift	10.843	0.200	standard							---	rectn
32.	Q7	Drift	11.043	0.340	multipole	-0.301	0.8000	13.00	0.34	yes	1	---	rectn
33.	dl18	Drift	11.383	0.500	standard							---	rectn
34.	VF1	Wien	11.883	2.365								---	rectn
35.	dl19	Drift	14.248	0.500	standard							---	rectn
36.	Hex3	Drift	14.748	0.260	multipole	+0.000	0.7999	11.00	0.26	yes	1	---	rectn
37.	dl20	Drift	15.008	0.280	standard							---	rectn
38.	Oct1	Drift	15.288	0.260	beam-line							---	rectn
39.	dl21	Drift	15.548	1.750	standard							---	rectn
40.	slits FP2	Drift	17.298	0.000	SLITS							---	rectn
41.	dl30	Drift	17.298	0.250	standard							HV	rectn
42.	Q12	Drift	17.548	0.300	multipole	-2.200	0.7999	7.00	0.30	yes	1	---	rectn
43.	dl31	Drift	17.848	0.300	standard							---	rectn
44.	Q13	Drift	18.148	0.300	multipole	+2.016	0.7999	5.00	0.30	yes	1	---	rectn

## “Distribution” method With set Angular Acceptances

Emittance

Beam CARD (sigma, semi-axis, half-width...)

1D - shape (Distribution method)

1. X mm	0.1	Gaussian
2. T mrad	60	Rectangle uniform
3. Y mm	0.1	Gaussian
4. P mrad	60	Rectangle uniform
5. L mm	0	Gaussian
6. D %	0.01	Rectangle uniform

statistics: 66Se

66Se Beta+ decay (Z=34, N=32)

Q1 (tuning)	21
Q2 (B1)	21
Q3 (B2)	21
Q4 (B3)	21
Q5 (B4)	21
Q6 (VF1)	21
Q7 (B7)	21
Q8 (B8)	21
Reaction	BEAM
Ion Production Rate (pps)	1.89e+9
<b>Total ion transmission (%)</b>	<b>30.239</b>
Total: this reaction (pps)	1.89e+9
Total: All reactions (pps)	1.89e+9
X-Section in target (mb)	beam
Target (%)	100
Q (Charge) ratio (%)	100
tuning (%)	33.45
X angular transmission (%)	43.83
Y angular transmission (%)	76.32
slits FP1 (%)	90.6
X space transmission (%)	100
Y space transmission (%)	90.6
d112 (%)	99.78
X angular transmission (%)	99.78
d130 (%)	100
X angular transmission (%)	100
Y angular transmission (%)	100

## “Monte Carlo” method With set Angular Acceptances No bounds

Angular Acceptance & Bounds

Use fixed angular acceptances

Use physical limits (aperture) inside blocks to calculate fragment transmission

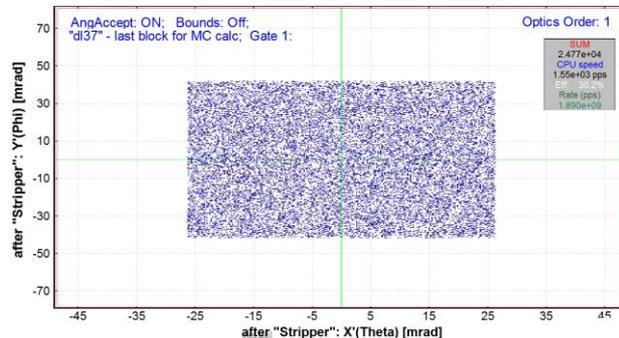
For block apertures LISE++ uses the slit limits accessible from the Block Cut & Acceptance dialog. (Pay attention there for the checkbox)

66Se : Monte Carlo Transmission Plot

66Se (3.1 MeV/u) + ; Transmitted Fragment 66Se21+...  
dp/p=14.49% ; Brho(TM) : 0.7988, 0.7988, 0.7988, 0.7988  
AngAccept: ON; Bounds: Off; "d137" - last block for

#	Ion	N of Passed	N of Initial	Transmission
All	66Se	24821	82070	30.24%
0	66Se	24772	81920	30.24% (+/-0.19%)

Target	100.0%
tuning	33.43%
Angular acceptance	33.43%
slits FP1	90.46%
Slits	90.46%



## “Monte Carlo” method No Angular Acceptances WITH bounds

Angular Acceptance & Bounds

Use fixed angular acceptances

Use physical limits (aperture) inside blocks to calculate fragment transmission

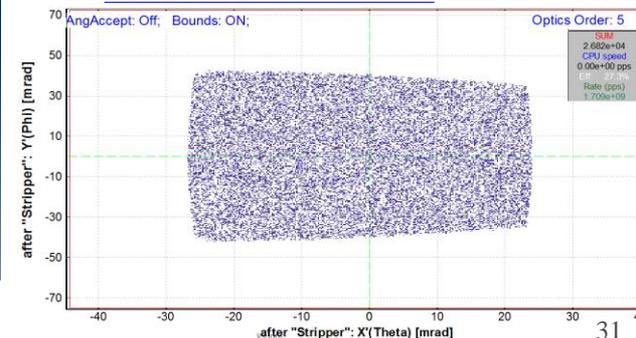
For block apertures LISE++ uses the slit limits accessible from the Block Cut & Acceptance dialog. (Pay attention there for the checkbox)

66Se : Monte Carlo Transmission Plot

66Se (3.1 MeV/u) + ; Transmitted Fragment 66Se21+...  
dp/p=14.49% ; Brho(TM) : 0.7988, 0.7988, 0.7988, 0.7988  
AngAccept: Off; Bounds: ON; "d137" - last block for

#	Ion	N of Passed	N of Initial	Transmission
All	66Se	26874	98253	27.35%
0	66Se	26824	98080	27.35% (+/-0.17%)

Target	100.0%
tuning	100.0%
d11	83.65%
Inside of bounds	83.65%
Q1	59.38%
Inside of bounds	59.38%
Q2	79.60%
Inside of bounds	79.60%
Q4	88.46%
Inside of bounds	88.46%

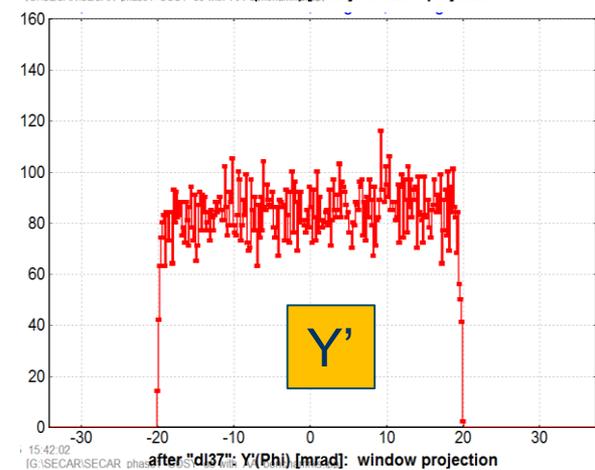
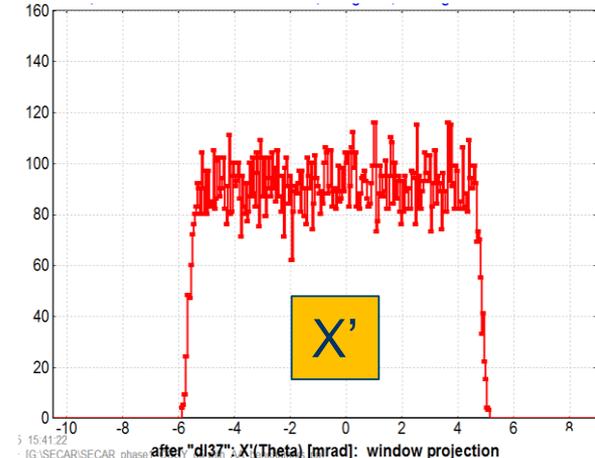
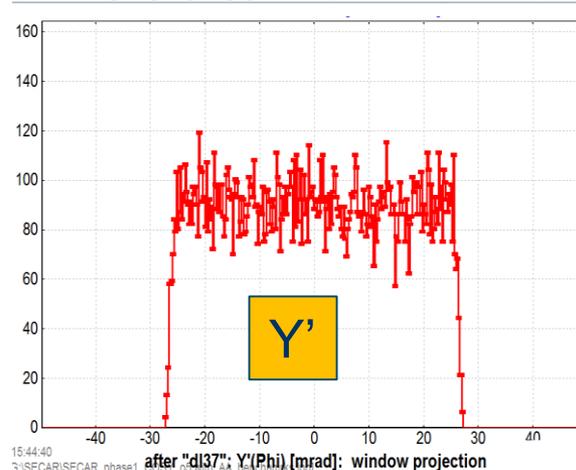
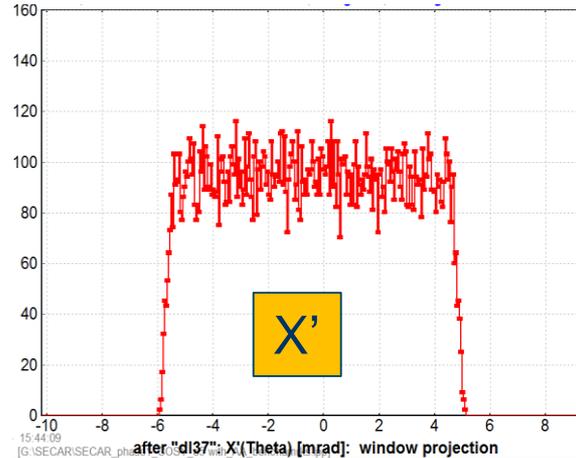
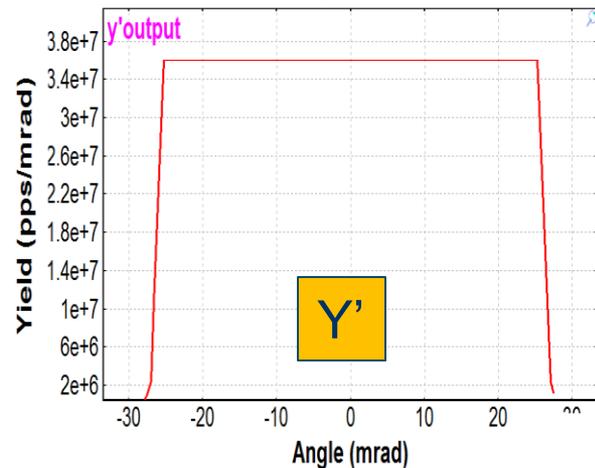
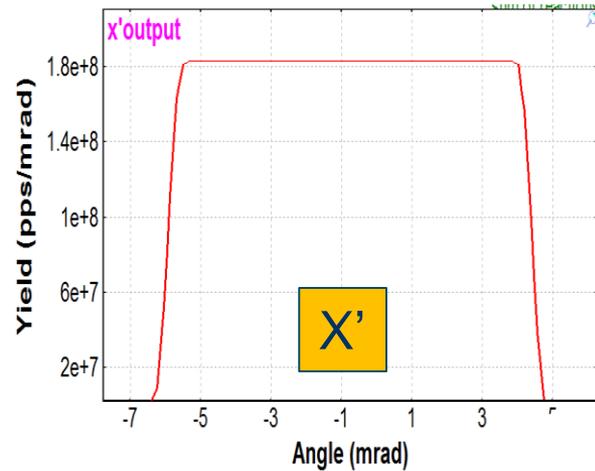


“Distribution” method  
With set Angular Acceptances

“Monte Carlo” method  
With set Angular Acceptances  
No bounds

“Monte Carlo” method  
No Angular Acceptances  
WITH bounds

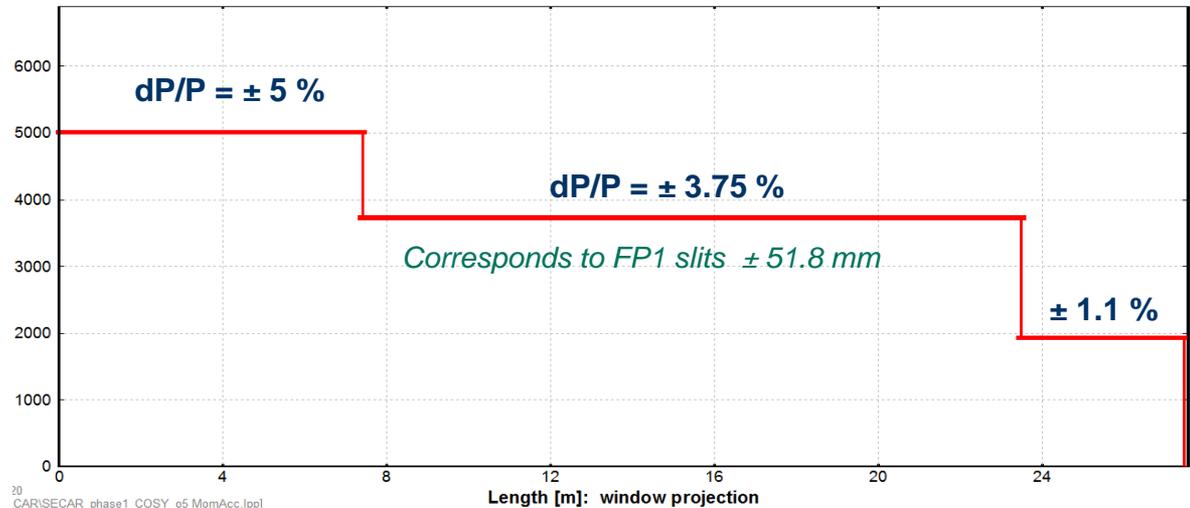
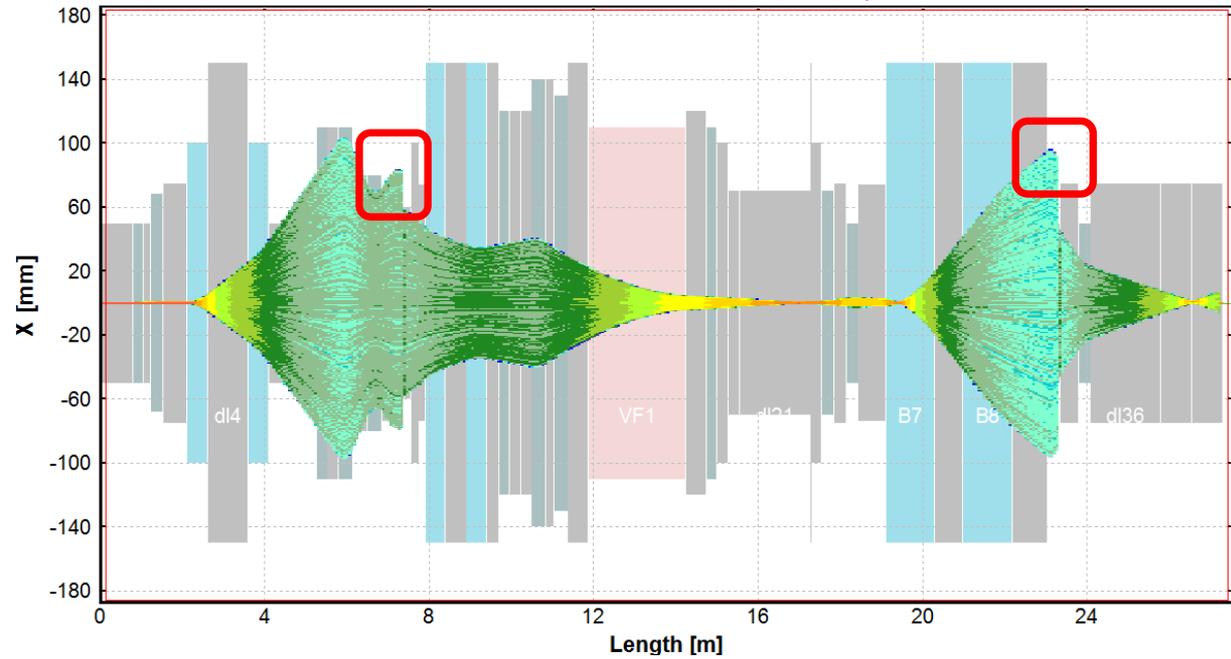
@ DL38



1<sup>st</sup> order

Emittance		
	Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X mm	0.1	Gaussian
2. T mrad	0.1	Gaussian
3. Y mm	0.1	Gaussian
4. P mrad	0.1	Gaussian
5. L mm	0	Gaussian
6. D %	5	Rectangle uniform

AngAccept: Off; Bounds: ON; "dl38" - last block for MC calc; no gates; Optics Order: 1



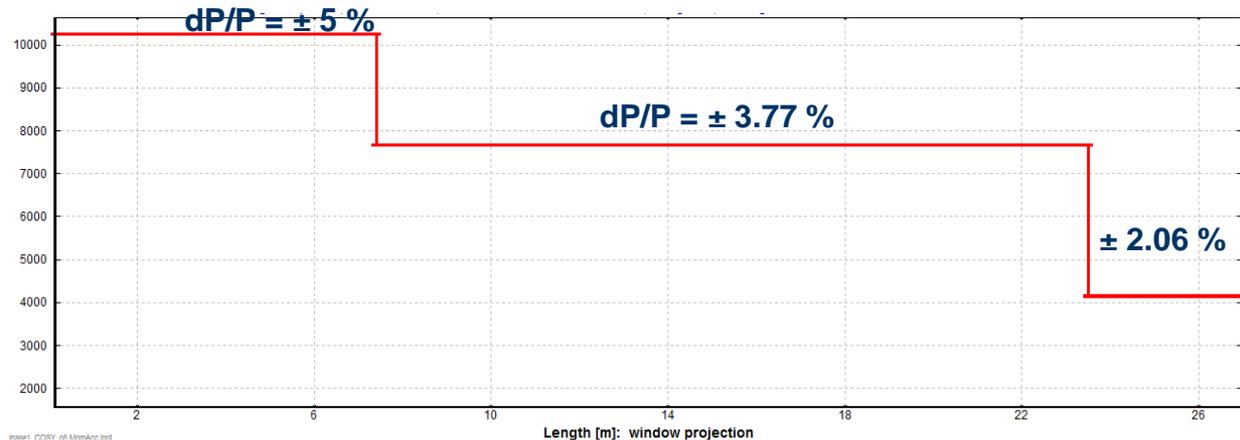
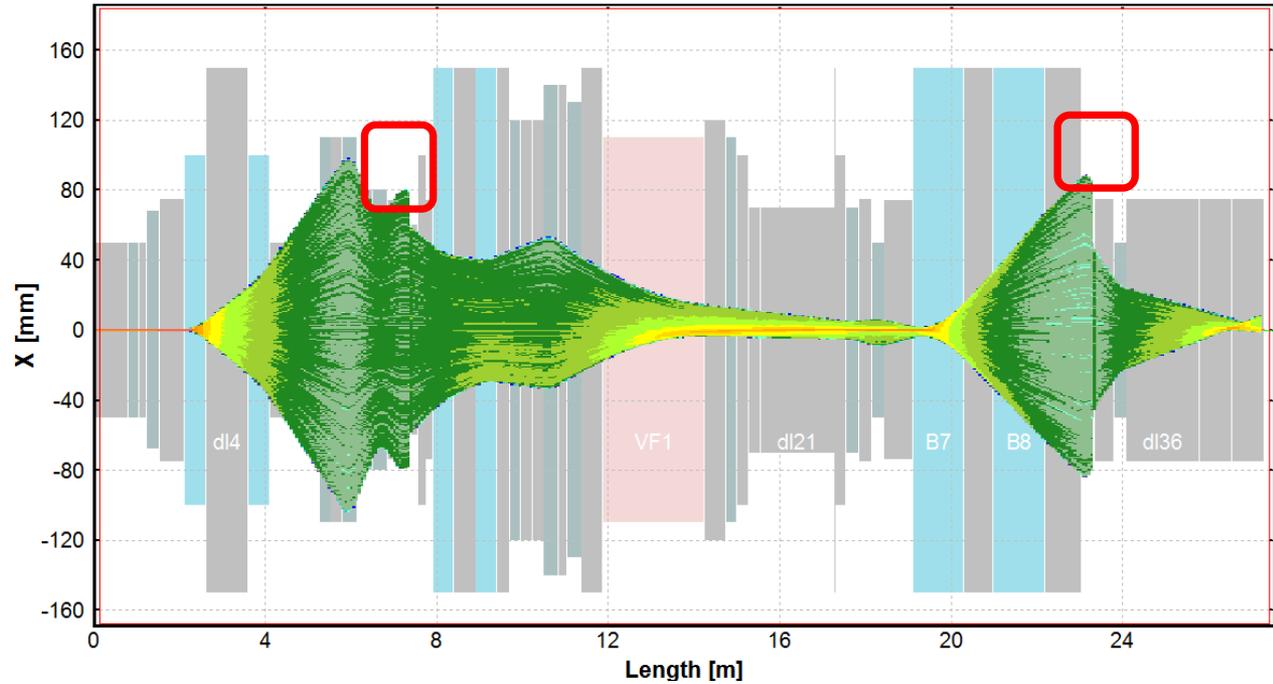
20 CARISSEAR phase1 COSY e5 MomAcc.lcol

Length [m]: window projection

AngAccept: Off; Bounds: ON; "dl38" - last block for MC calc; no gates; Optics Order: 5

5<sup>th</sup> order

Emittance		
	Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X	mm 0.1	Gaussian
2. T	mrad 0.1	Gaussian
3. Y	mm 0.1	Gaussian
4. P	mrad 0.1	Gaussian
5. L	mm 0	Gaussian
6. D	% 5	Rectangle uniform



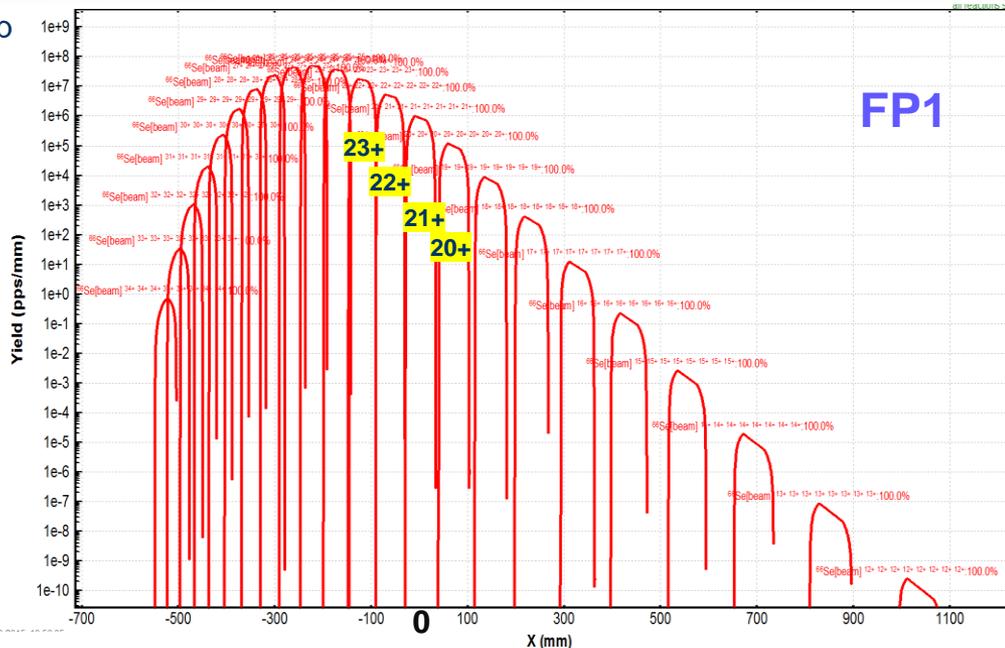
source: CERN/ATLAS/2011

Length [m]: window projection

# Charge States Selection: "Distribution" method

File: e\_SECAR\_phase1\_COSY\_o5.lpp

No slits, no apertures



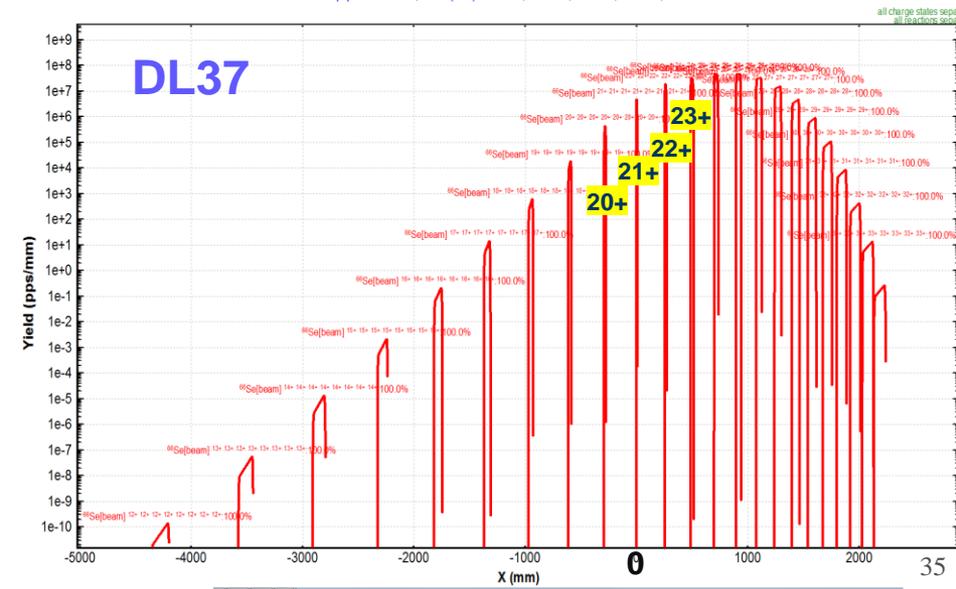
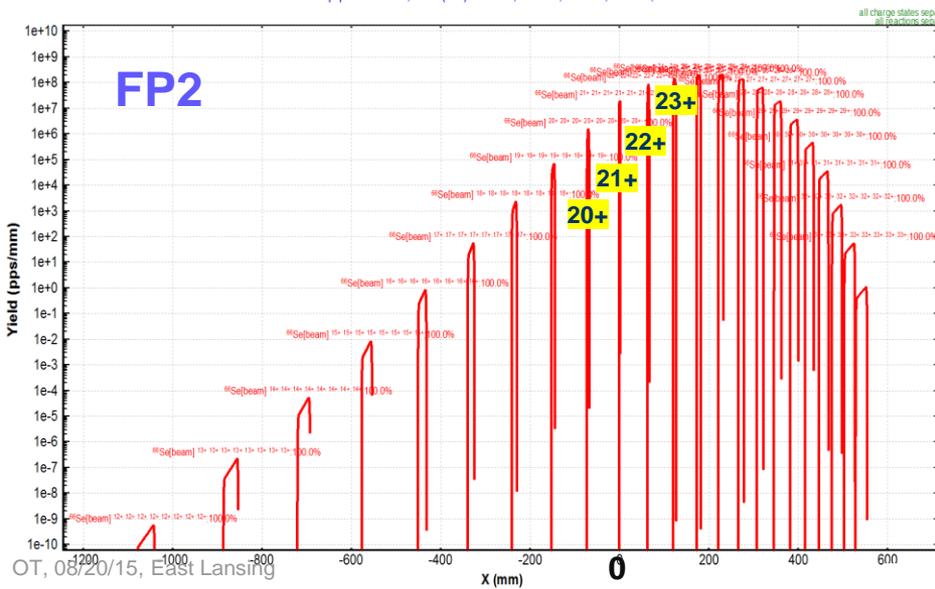
FP1

slits FP2 : Beam & SetFragment Charge States

<sup>66</sup>Se (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Settings on <sup>66</sup>Se<sup>21+, 21+</sup>; Config: DSSSSSDSDSSSSSSSSSSSSSDSDS...  
dp/p=100.00%; Brho(Tm): 0.7988, 0.7988, 0.7988, 0.7988, 0.7988

dl37 : Beam & SetFragment Charge States

<sup>66</sup>Se (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Settings on <sup>66</sup>Se<sup>21+, 21+</sup>; Config: DSSSSSDSDSSSSSSSSSSSSSDSDS...  
dp/p=100.00%; Brho(Tm): 0.7988, 0.7988, 0.7988, 0.7988, 0.7988...



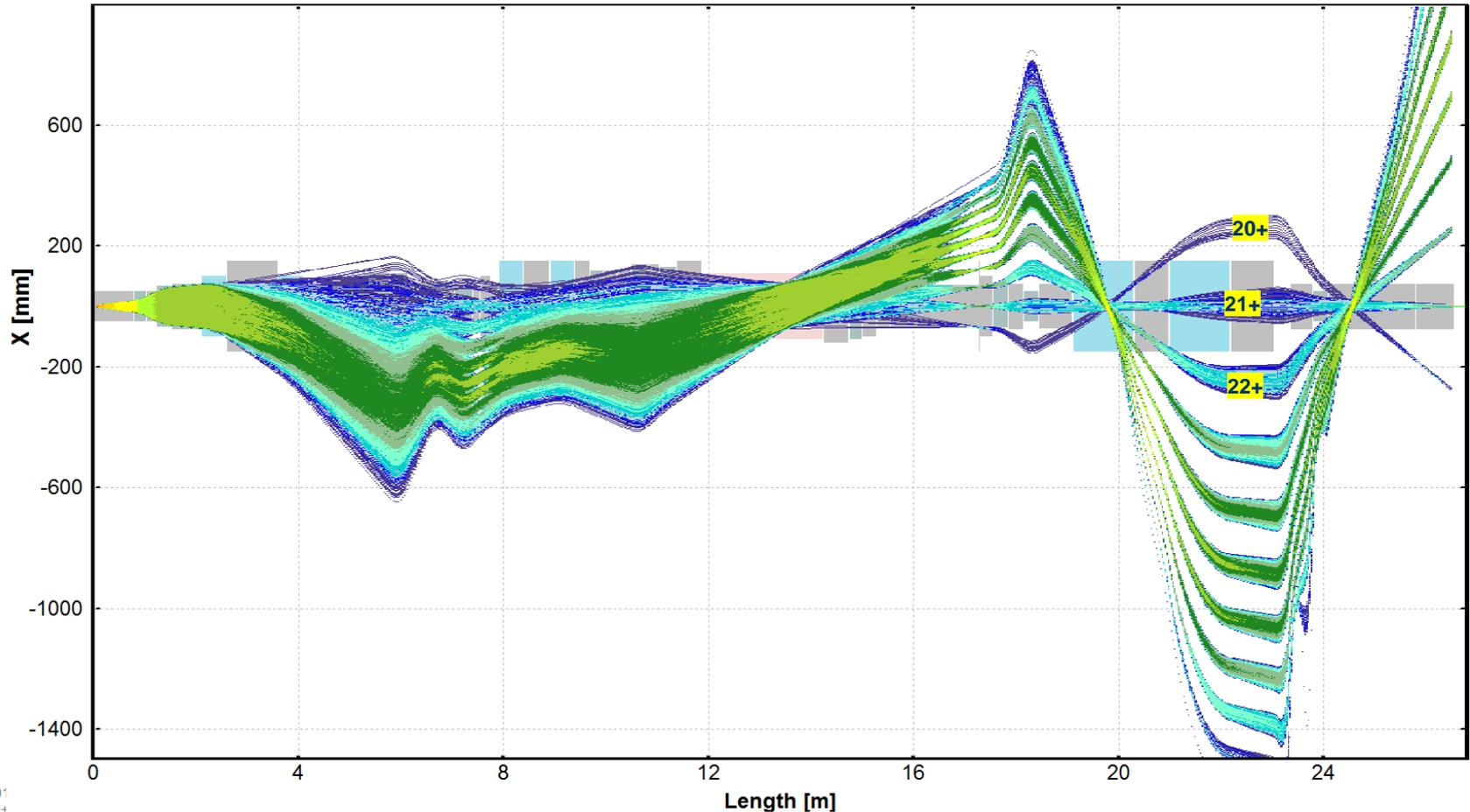
No slits, no apertures

1<sup>st</sup> order

## Isotope Group : MC Yield Plot - Envelope (only passed)

<sup>66</sup>Se (3.1 MeV/u) + Be (1e-4 mg/cm<sup>2</sup>); Transmitted Fragment <sup>66</sup>Se<sup>21+..21+</sup> (beam); Optics Order: 1  
 dp/p=100.00% ; Brho(Tm): 0.7988, 0.7988, 0.7988, 0.7988, 0.7988....

AngAccept: Off; Bounds: Off; "dl37" - last block for MC calc; no gates; Config: DSSSSSDSDSSSSSSSSSSSSSSSDSD!



01  
++

1. X	mm	0.75	Rectangle uniform
2. T	mrاد	25	Rectangle uniform
3. Y	mm	0.75	Rectangle uniform
4. P	mrاد	25	Rectangle uniform
5. L	mm	0	Gaussian
6. D	%	1.5	Rectangle uniform

1<sup>st</sup> order

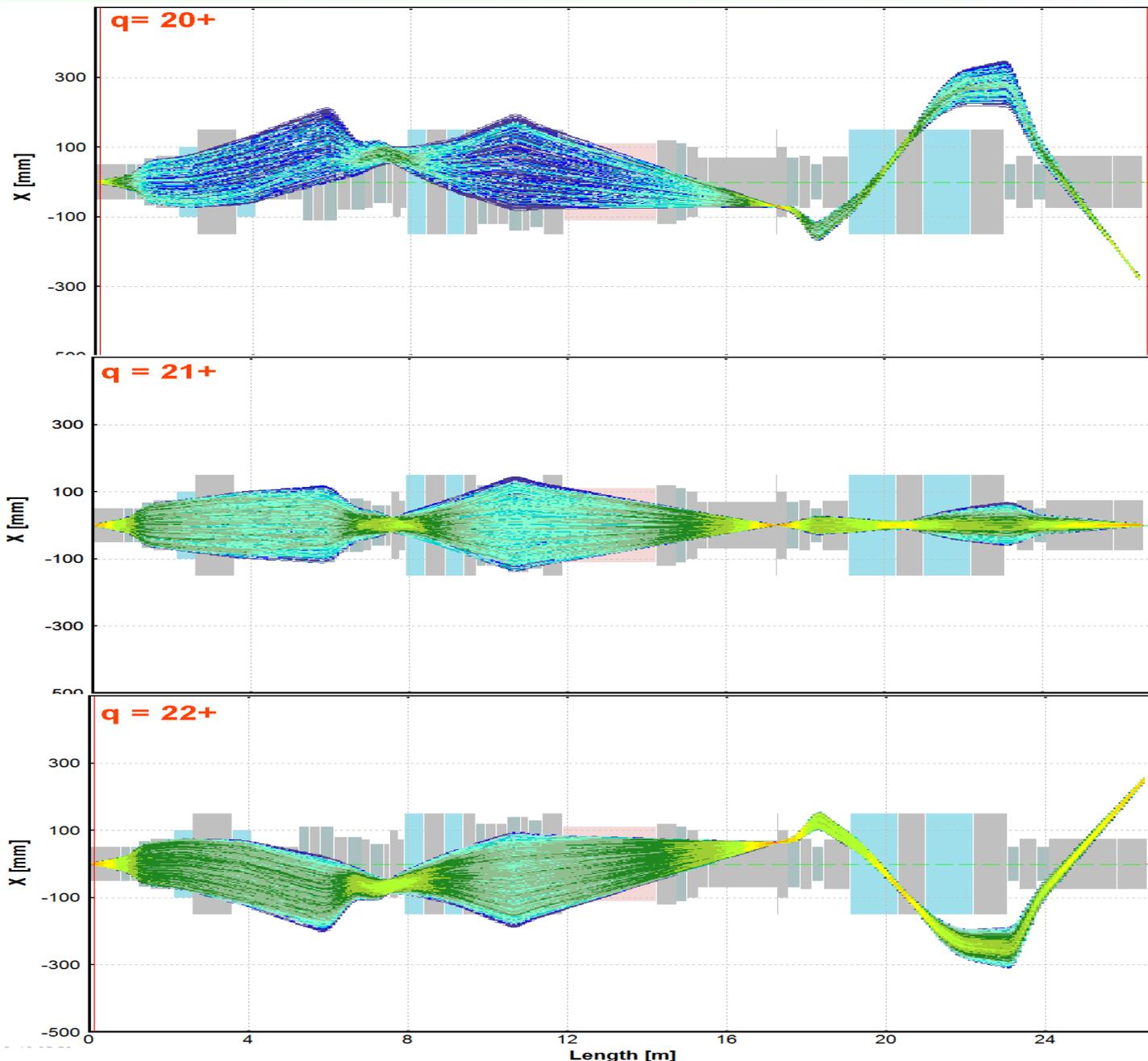


Table 3.14. Transmission results for a set of crucial reactions from the target to the final focus in the single VF system.

Reaction	Energy (MeV/u)	Transmission
$^{15}\text{O}(\alpha, \gamma)^{19}\text{Ne}$	0.3	95

## LISE++ settings

File: e\_SECAR\_phase1\_reaction.lpp

### Target

Gas density

He These calculations are correct just for molecular formula !!!

Parameter	Value	Dimension
Temperature (K)	293.15	K
Pressure (Torr)	10 / 760	Torr
Density	0.00219 / 0.166	mg/cm3 kg/m3 g/L

Units converter    Fix    Cancel

Target

He Density 2.1897e-6 g/cm3

Use in Q-state calculations    Calculate density

Z	Element	Mass	Stoich
<input checked="" type="checkbox"/>	2 He	PT 4.003	1
<input type="checkbox"/>	14		

Compound dictionary

State:  Solid  Gas    Dimension:  mg/cm2 & micron  g/cm2 & mm    Angle: 0 degrees

Thickness at 0 degrees:  100 mm  2.1897e-5 g/cm2

Effective Thickness:  100 mm  2.1897e-5 g/cm2

Thickness defect    Absorbed Dose

d / Range (beam) 0.042    Energy Loss in the target box [KW] 2.91e-5    Atoms / cm2 3.29e+18

OK    Cancel

### Beam

Beam

A Element q+    Beam energy

15 0 5    Energy  0.3 MeV/u

8    TKE  4.5 MeV

Z    Btho  0.2366 Tm

Beta+ decay    P  0.3547 GeV/c

U  900 KV

Table of Nuclides

Z    Beam intensity

N     500 enA

OK     100 pA

Cancel     6.25e+11 pps

0.00045 KW

Emittance

Beam CARD (sigma, semi-axis, half-width...)

1D - shape (Distribution method)

1. X mm 0.75 Rectangle uniform

2. T mrad 1 Rectangle uniform

3. Y mm 0.75 Rectangle uniform

4. P mrad 1 Rectangle uniform

5. L mm 0 Gaussian

6. D % 1 Rectangle uniform

Energy Loss in the target box [KW] 2.91e-5

### Production mechanism

Settings     Fusion -> Residual

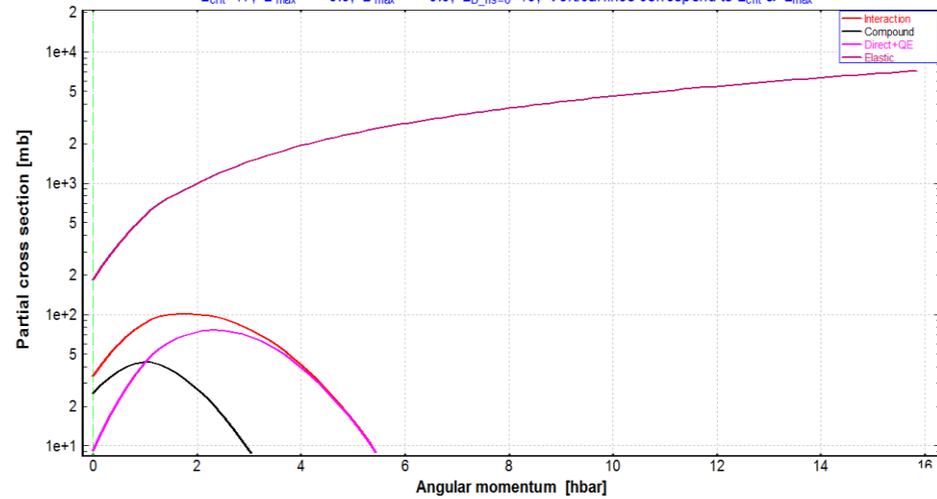
Charge states: 5 - [ < 15AMeV ] G.Schiwietz, P.Grande, NIM B175-177 (2001) 125-131

Energy Losses: 1 - [H -base] J.F.Ziegler et al, Pergamon Press, NY (low energy)

## Partial cross sections

$^{15}\text{O}(0.3 \text{ MeV/u}) + ^4\text{He} \rightarrow ^{19}\text{Ne}^* (E_{\text{CM}}=0.9 \text{ MeV})$ ; [no  $P_{\text{CN}}$ , Penetration $^{\text{Q.M}}$ ]  
 Cross Sections[mb]: Intr=3.61e+02; Comp=1.07e+02; QE=2.54e+02;

$L_{\text{crit}}=17$ ;  $L_{\text{max}}^{\text{Graz}}=0.0$ ;  $L_{\text{max}}^{\text{LISE}}=0.0$ ;  $L_{\text{B, fis}=0}=19$ ; Vertical lines correspond to  $L_{\text{crit}}$  &  $L_{\text{max}}$



**Fusion information window**

$15\text{O}(0.3 \text{ MeV/u}) + \text{He} \rightarrow ^{19}\text{Ne}^* \rightarrow ^{19}\text{Ne}$

Q-value of reaction = 3.528 MeV  
**Fusion max barrier = 2.80 MeV**  
 Fusion radius = 7.15 fm

Depending on a place of reaction in the target

	beginning	middle	end
Beam energy (Lab) [MeV/u]	0.30	0.29	0.28
Beam energy (Lab) [MeV]	4.5	4.3	4.2
<b>Center of mass energy [MeV]</b>	<b>0.95</b>	<b>0.92</b>	<b>0.88</b>
Excitation energy [MeV]	4.48	4.44	4.41
Compound recoil energy [MeV]	3.6	3.4	3.3

Fusion cross section [mb] 130 130 129  
 Fusion- 1st Fission CS [mb] 0 0 0  
 Fusion-Breakup CS [mb] 0 0 0

for setting residue after the stripper

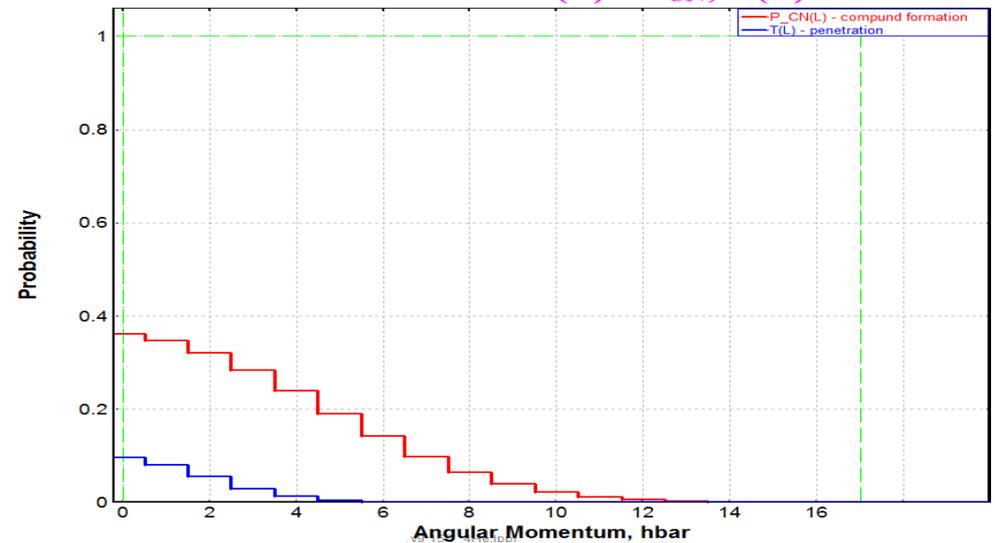
Energy diapason (MeV/u) 0.170 ⇄ 0.174  
 Corresponding ion charge state 3.31 ⇄ 3.35

Plot the excitation function

All fusion characteristics are calculated with BASS-model  Fusion-Residue calculator

Quit

## Probabilities as f(L): $P_{\text{CN}}$ , $T(L)$

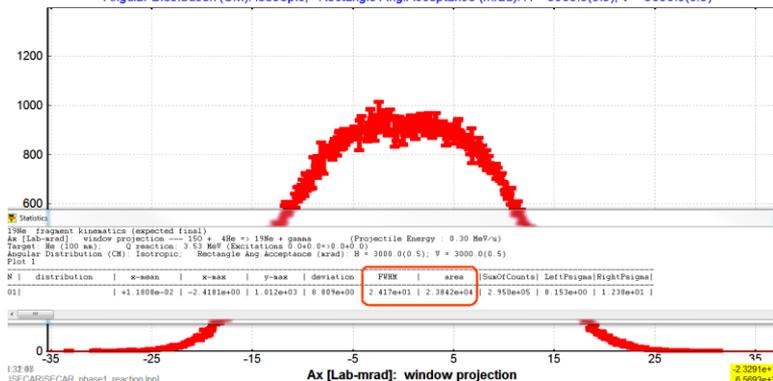


Please check the kinematics discussion for the DRAGON separator  
[http://lise.nsci.msu.edu/9\\_10/DRAGON/DRAGON.pdf#page=51](http://lise.nsci.msu.edu/9_10/DRAGON/DRAGON.pdf#page=51)

# Experiment $^{15}\text{O}(\alpha, \gamma)^{19}\text{Ne}$ : two-body kinematics

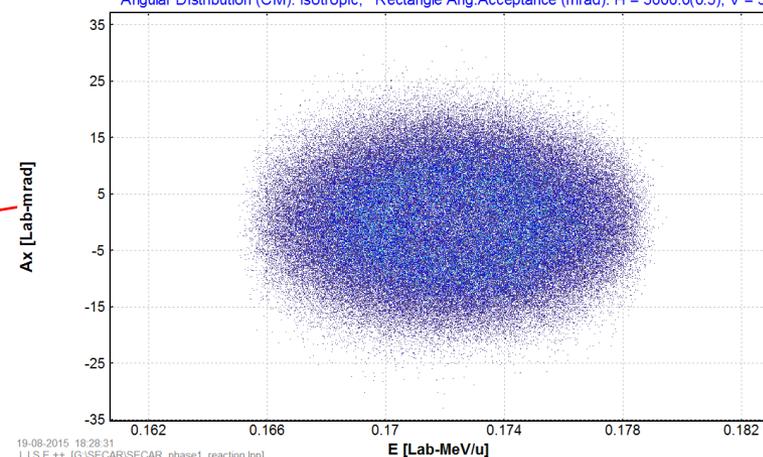
## $^{19}\text{Ne}$ fragment kinematics (expected final)

Ax [Lab-mrad]: window projection ---  $^{15}\text{O} + ^4\text{He} \Rightarrow ^{19}\text{Ne} + \gamma$  (Projectile Energy : 0.30 MeV/u)  
 Target: He (100 mm); Q reaction: 3.53 MeV (Excitations 0.0+0.0=>0.0+0.0)  
 Angular Distribution (CM): Isotropic; Rectangle Ang.Acceptance (mrad): H = 3000.0(0.5); V = 3000.0(0.5)



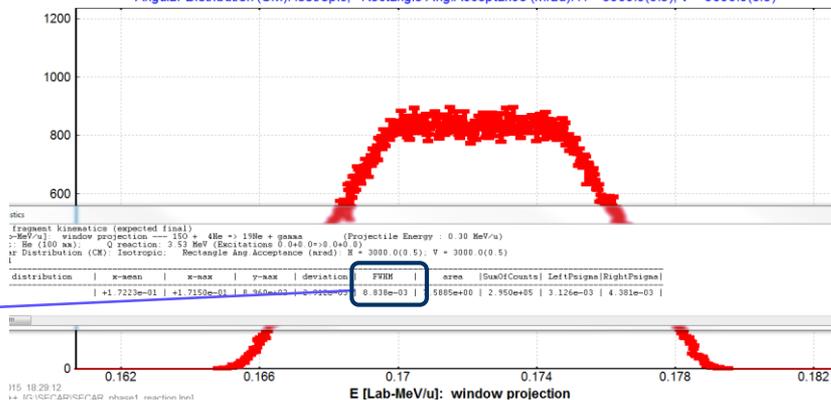
## $^{19}\text{Ne}$ fragment kinematics (expected final)

$^{15}\text{O} + ^4\text{He} \Rightarrow ^{19}\text{Ne} + \gamma$  (Projectile Energy : 0.30 MeV/u)  
 Target: He (100 mm); Q reaction: 3.53 MeV (Excitations 0.0+0.0=>0.0+0.0)  
 Angular Distribution (CM): Isotropic; Rectangle Ang.Acceptance (mrad): H = 3000.0(0.5); V = 3000.0(0.5)



## $^{19}\text{Ne}$ fragment kinematics (expected final)

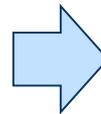
E [Lab-MeV/u]: window projection ---  $^{15}\text{O} + ^4\text{He} \Rightarrow ^{19}\text{Ne} + \gamma$  (Projectile Energy : 0.30 MeV/u)  
 Target: He (100 mm); Q reaction: 3.53 MeV (Excitations 0.0+0.0=>0.0+0.0)  
 Angular Distribution (CM): Isotropic; Rectangle Ang.Acceptance (mrad): H = 3000.0(0.5); V = 3000.0(0.5)



It's corresponds to initial rectangle emittance  $dp/p = \pm 1.8\%$

In order to obtain distributions corresponding to two-boy kinematics HI+gamma it is possible to change the initial beam emittance as

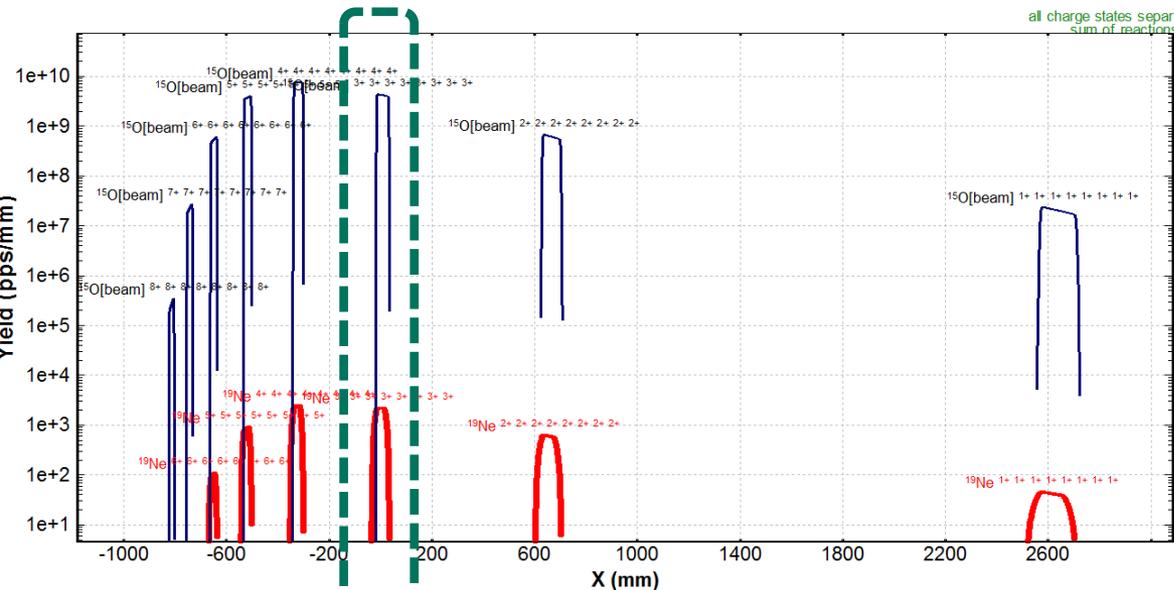
Emittance		
	Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X mm	2	Gaussian
2. T mrad	1	Gaussian
3. Y mm	2	Gaussian
4. P mrad	1	Gaussian
5. L mm	0	Gaussian
6. D %	1	Gaussian



Emittance		
	Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X mm	0.75	Gaussian
2. T mrad	8.9	Gaussian
3. Y mm	0.75	Gaussian
4. P mrad	8.9	Gaussian
5. L mm	0	Gaussian
6. D %	1.8	Rectangle uniform

## slits FP1-Xspace: output after slits

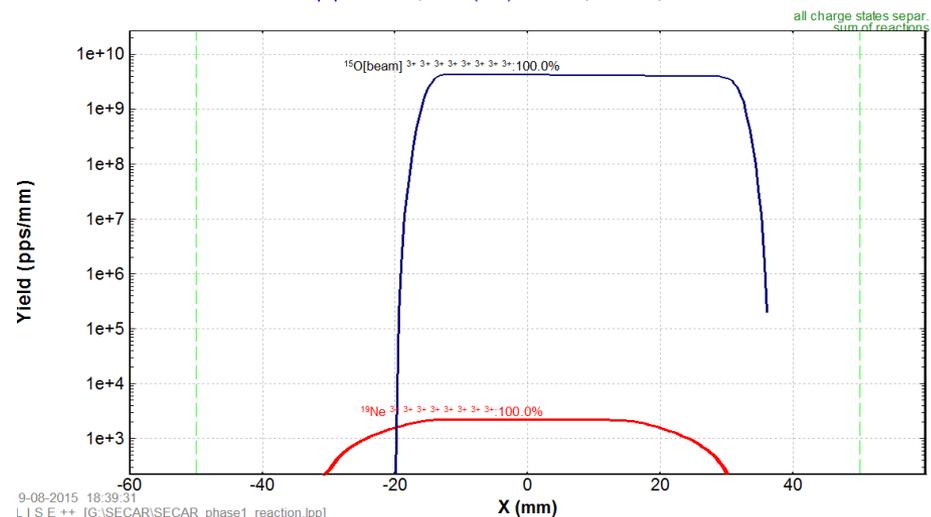
$^{15}\text{O}$  (0.3 MeV/u) + He (100 mm); Settings on  $^{19}\text{Ne}^{3+..3+}$ ; Config: DSSFSSSFSDSDFSSSFSSSFSSSF...  
 dp/p=100.00% ; Brho(Tm): 0.3783, 0.3783, 0.3783

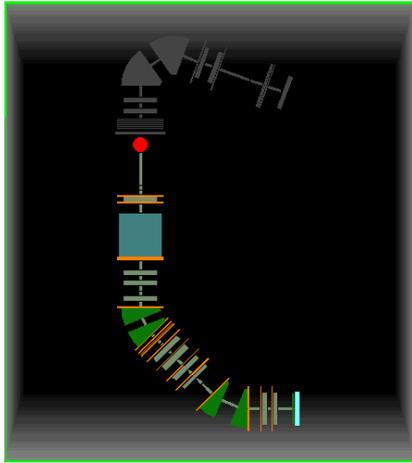


@ FP1 slits →

## slits FP1-Xspace: output before slits

$^{15}\text{O}$  (0.3 MeV/u) + He (100 mm); Settings on  $^{19}\text{Ne}^{3+..3+}$ ; Config: DSSFSSSFSDSDFSSSFSSSFSSSF...  
 dp/p=7.65% ; Brho(Tm): 0.3783, 0.3783, 0.3783

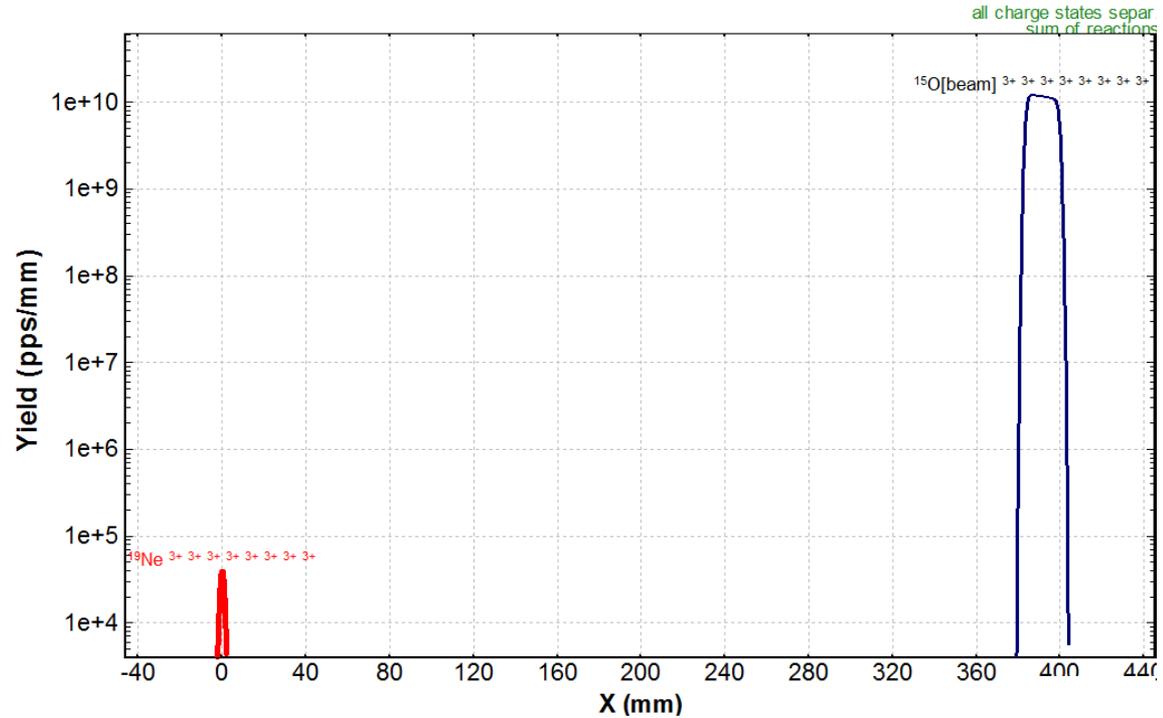




*In front of the Mass Slits (FP2) with the Charge slits and Angular acceptances*

## dl21-Xspace: output after slits

$^{15}\text{O}$  (0.3 MeV/u) + He (100 mm); Settings on  $^{19}\text{Ne}^{3+..3+}$ ; Config: DSSFSSFSFDSDFFSSSFSSF;  
dp/p=7.65% ; Brho(Tm): 0.3783, 0.3783, 0.3783, 0.3783, 0.3783



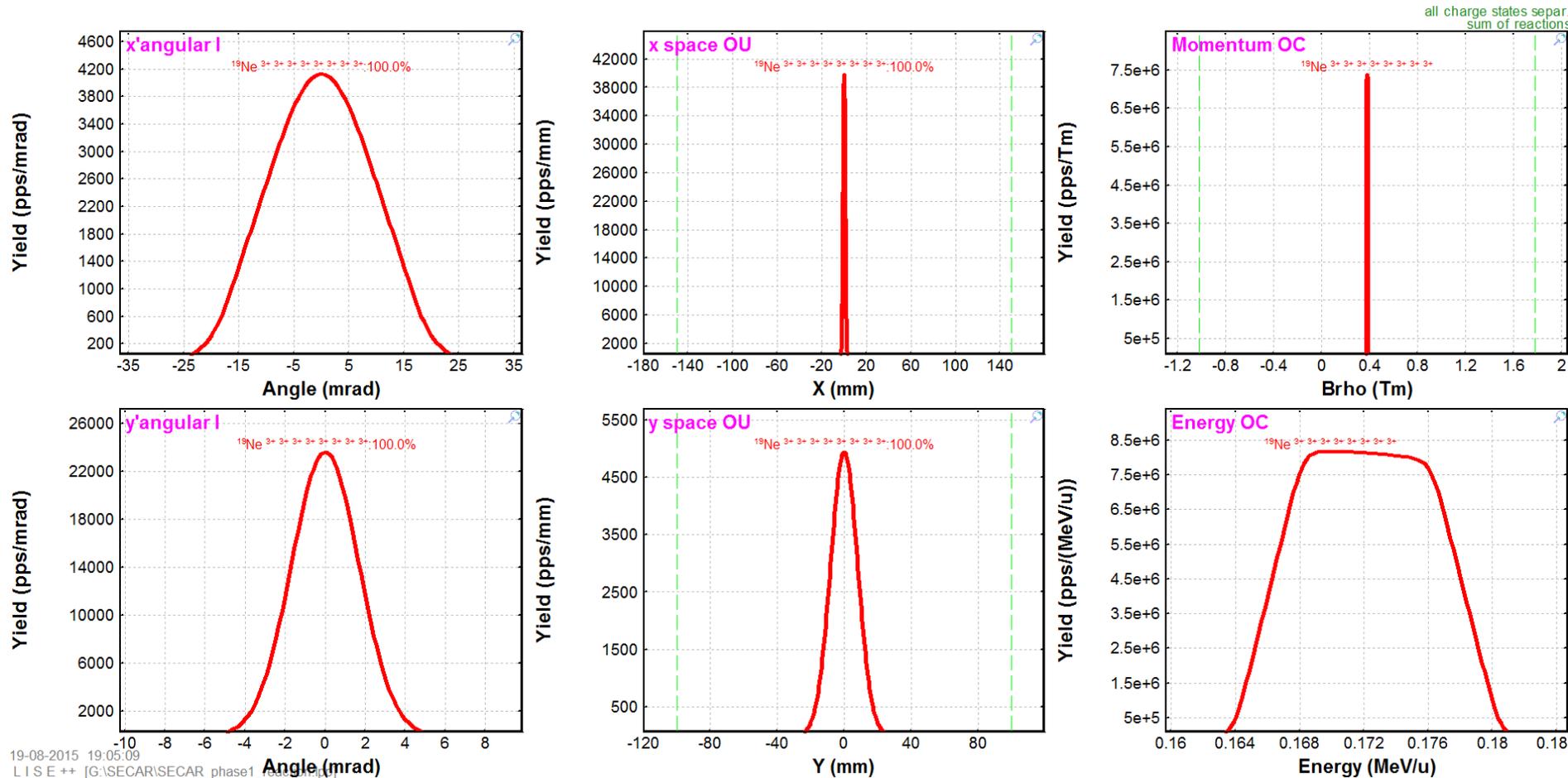
Pay attention for The Wien filter parameters!!!  
The purpose of E(or B) choice is to compensate dispersion after dipoles!

	VF1	E	300 KV/m
		B	520.67 G
		DL	3.81 mm/%

## $^{19}\text{Ne}^{3+}$ after the Mass Slits (FP2)

### slits FP2

$^{15}\text{O}$  (0.3 MeV/u) + He (100 mm); Settings on  $^{19}\text{Ne}^{3+..3+}$ ; Config: DSSFSSFSFDSDFFSSSFSSSFSSF...  
dp/p=7.65% ; Brho(Tm): 0.3783, 0.3783, 0.3783, 0.3783, 0.3783....



$^{19}\text{Ne}^{3+}$  after the DL37

Only  $^{19}\text{Ne}^{3+}$  passing through the separator !

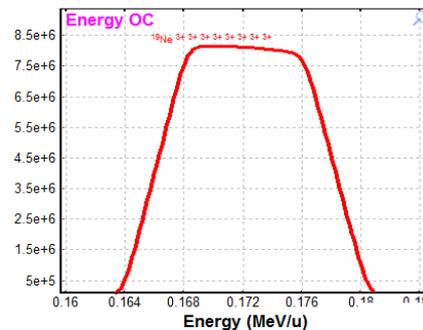
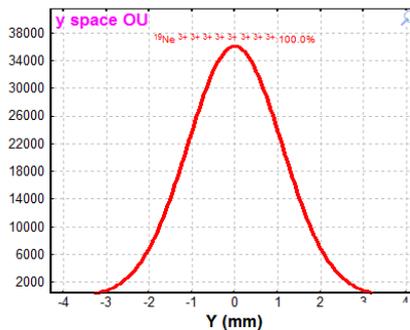
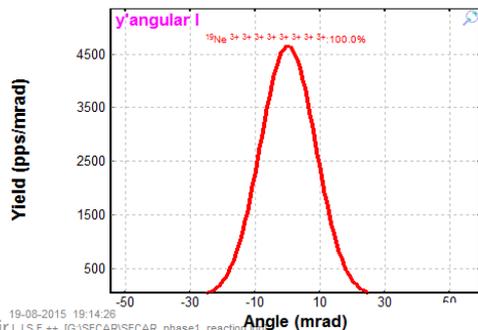
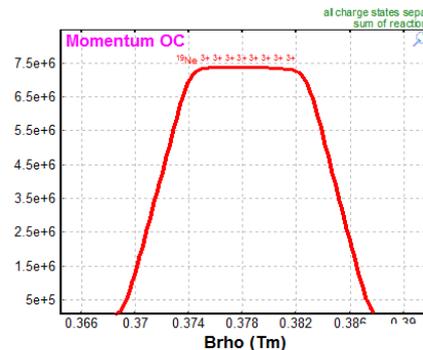
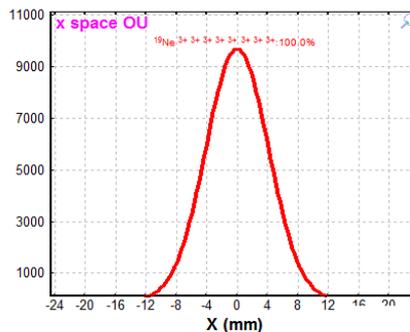
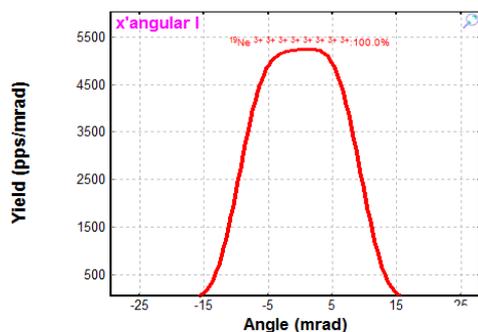
19Ne Beta+ decay (Z=10, N=9)

Q1 (tuning)		3
Reaction		FusRes
Ion Production Rate (pps)		9.9e+4
Total ion transmission (%)		37.077
Total: this reaction (pps)		9.9e+4
Total: All reactions (pps)		9.9e+4
X-Section in target (mb)		1.3e+2
Target (%)		39.09
Unreacted in material (%)		100
Q (Charge) ratio (%)		39.09
Unstopped in material (%)		100
tuning (%)		99.32
X angular transmission (%)		99.32
Y angular transmission (%)		100
d112 (%)		95.59

$^{19}\text{Ne}^{3+}$  transmission 94.8%  
Main cut by the 2-nd horizontal angular acceptance

d137

$^{15}\text{O}$  (0.3 MeV/u) + He (100 mm); Settings on  $^{19}\text{Ne}^{3+..3+}$ ; Config: DSSFSSFSDFSSSFSSSFSSSFSSF...  
dp/p=7.65% ; Brho(Tm): 0.3783, 0.3783, 0.3783, 0.3783, 0.3783....



19-08-2015 19:14:26

## Extended

Detail configuration for experts

90 blocks

## Segmented

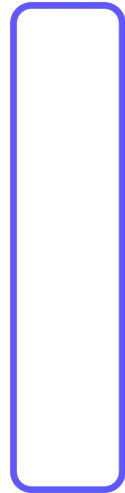
“Easy” configuration for regular users

11 blocks (5 sectors, 3 material blocks and 3 slits)





Pay attention for cut settings:  
4 angular acceptances, 3 slits



5 sectors  
(segments)

## Open Questions:

1. Develop the two-body kinematics mechanism in the case  $Hl$  &  $\gamma$
2. Primary beam scattering (large angles)
3. Wien characteristics utility to compensate dipole dispersion

## Acknowledgement:

to Hendrik Schatz and Fernando Motes for documents and files providing,  
to Mauricio Portillo with COSY actions

