

LISE++ Version 9.10.256  
from 01/06/2016

**Use the latest version!**

- Important updates and modifications recently done
- Reaction mechanism settings
- Beam & Target settings
- Separator settings (*geometry, angular acceptance, charge states*)
- Optics Optimization
- Matrix & Beam sigma envelopes
- Monte Carlo transmission simulation
- Residue transmission analysis
- Primary beam scattering
- Primary beam charge state transmission

## LISE<sup>++</sup> code :

- Correction in angular straggling subroutines for low energy use
- Implementation of the Multi-layers method in MC mode for qualitative estimation of angular straggling and Coulomb scattering
- Modification and correction in the Optics optimizer utility
- Utility “Angular Straggling & Rutherford scattering probabilities”
- Possibility to simulate primary beam scattering

## SHELS configuration file :

- Using stripping foil after a target
- Modification of initial emittance (shapes and values)
- Using fixed effective lengths
- Modification of configuration geometry based on the Word file from Autumn 2015 (length, slits and so on)
- Setting reaction mechanism parameters to obtain 300nb 2n-residue cross section

## $^{48}\text{Ca}(221 \text{ MeV}) + \text{Bi}$

**Fission Barrier**

A Element Z  
257 Lr 103

Cohen barrier information  
Barrier vanishes at = 64 hbar

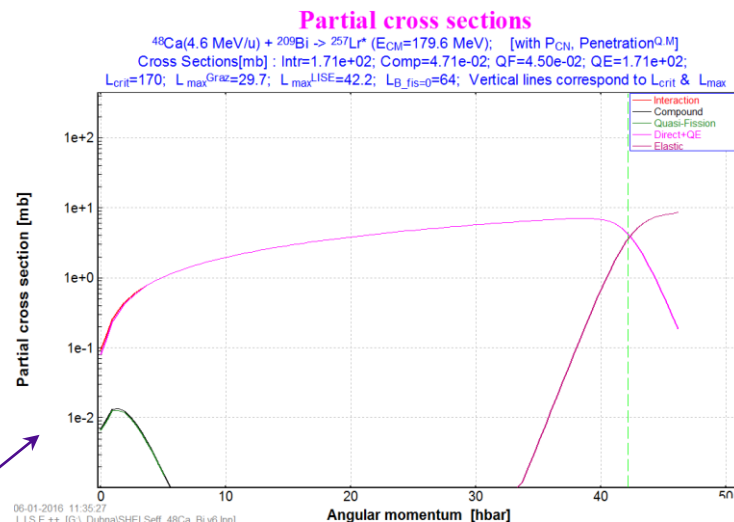
For models # 0,1,2  
Barfac = 3.4 factor to multiply the fission barrier (default value 1)

Use the code

Use the code	Fission Barrier at L=0	Fission Barrier at Lx = 10	G.S. Energy at Lx (MeV)
0 - "Barfit" -> invalid for this isotope(A,Z)	4.67		
1 - "FisRot" - S.Cohen et al.,An.P.82(1974)	5.7	5.56	0.32
2 - LDM - W.Myers, W.Swiatecki,NP81(1966)	5.8		
3 - FILE: A.Mamdouh et al,NPA679(2001)337	5.8		
4 - FILE: Experimental barriers			
5 - FILE: P.Moller et al.,LANL-UR-08-4190	5.9		
6 - FILE: P.Moller et al.,PRC91(2015)024310	5.9		

Ok Cancel Help

The "Barfit" model was used with BarFac=3.4, That gives the fission barrier for  $^{257}\text{Er}$  equal to 5.7 MeV @ L=0, Then P.Moller's data give a little bit more (5.9 MeV)



**Fusion -> Residues**

Evaporation settings  $^{48}\text{Ca}(4.6 \text{ MeV/u}) + ^{209}\text{Bi} \rightarrow ^{257}\text{Lr}^* (E_{\text{ex}}=24.5 \text{ MeV})$  Fission barrier

Fusion properties

Transmission probability for a one-dimensional potential barrier  
Classical  Quantum-mechanical

$h_{\text{omega}}$  - Curvature parameter of the parabolic potential describing the barrier (default value 3 MeV)  MeV

Probability for compound nucleus formation P<sub>(CN)</sub>  
 Take into account the Probability for compound nucleus formation P<sub>(CN)</sub> according to V.Zagrebaev & W.Greiner, PRC78, 034610 (2008)

Fission barrier vanishing  
 Take into account the Fission barrier vanishing with  
0 - "Barfit" - A.J.Sierk, PRC33(1986)2039  
1 - "FisRot" - S.Cohen et al.,An.P.82(1974)

Nuclear potential  
 Bass formalism  
 Wood-Saxon  
V0 = 105 MeV  
R0 = 1.12 fm  
a = 0.75 fm

Calculation  
L (Bis=0) = 64  
L critical = 170  
L direct (@ CpCt) = 1  
L max (grazing) = 29.7  
L max (@ Rint) = 42.2

Fusion L-diffuseness 1 MeV

Partial Cross Sections  
Potentials  $V_i = f(R)$   
T.PCN,dEx-chan as f(L)

Barrier properties as f(L)  
Bass Fusion CS & Barrier  
2D: Barrier  $V=f(R,L)$  & dVdR

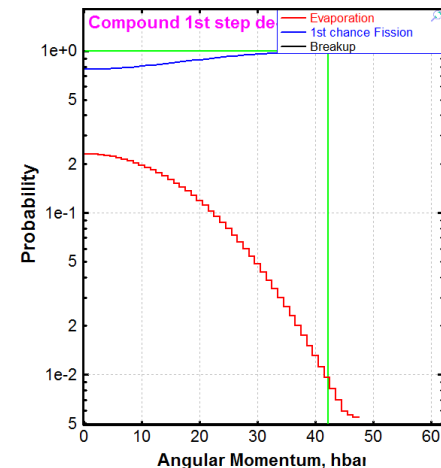
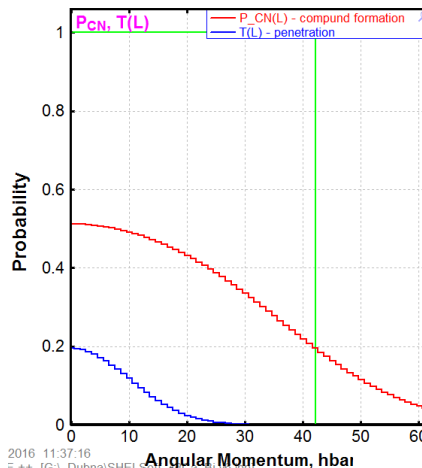
Partner site  
Fusion  
Evaporation

General reaction characteristics  
Fusion information window

OK Cancel Help

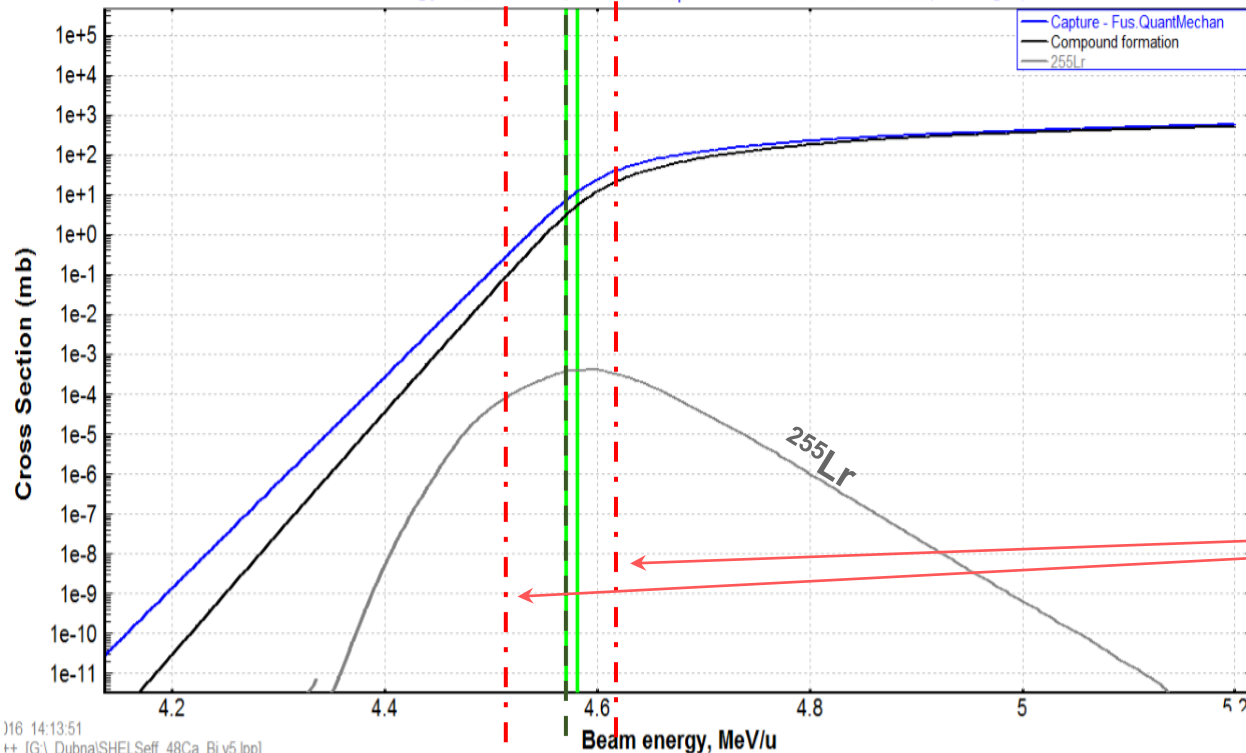
**Probabilities as f(L)**

$^{48}\text{Ca}(4.6 \text{ MeV/u}) + ^{209}\text{Bi} \rightarrow ^{257}\text{Lr}^* (E_{\text{CM}}=179.6 \text{ MeV})$ ;  $h_{\text{omega}}=4.0$   
 $L_{\text{crit}}=170$ ;  $L_{\text{max}}^{\text{Graz}}=29.7$ ;  $L_{\text{max}}^{\text{LISE}}=42.2$ ; Nuclear potential: WoodSaxon  
Vertical lines correspond to  $L_{\text{critical}}$  &  $L_{\text{maximum}}$



## Cross sections (Fusion-Residual) [with P\_{CN}]

$^{48}\text{Ca} + ^{209}\text{Bi} \rightarrow ^{257}\text{Lr}^*$  ( $Q = -155.09$ ) Model: LisFus v.4.0 Fis.Bar.MeV=5.70 "FisRot" - RLDM(Cohen)  
 $V_{\text{Coulomb}} = 176.64$  MeV; Fusion height  $B_{\text{max}}^{\text{Bass}}$ :  $B_f = 178.54$  MeV;  $h_{\text{omega}} = 4.00$  MeV  
 Beam energy:  $E_{\text{Lab}} = 4.61$  MeV/u,  $NP_{\text{evap}}=64$ ; Vert.lines:  $B_f$  &  $E_{\text{beam}}(1/2 \text{ target})$



**Fusion information window**

$^{48}\text{Ca}(4.6 \text{ MeV/u}) + ^{209}\text{Bi} \rightarrow ^{257}\text{Lr}^* \rightarrow ^{255}\text{Lr}$

Q-value of reaction = -155.090 MeV  
 Fusion max.barrier = 178.54 MeV  
 Fusion radius = 12.45 fm

Depending on a place of reaction in the target			
	beginning	middle	end
Beam energy (Lab) [MeV/u]	4.61	4.57	4.53
Beam energy (Lab) [MeV]	221.0	219.2	217.3
Center of mass energy [MeV]	179.64	178.13	176.63
Excitation energy [MeV]	24.55	23.04	21.54
Compound recoil energy [MeV]	41.4	41.0	40.7
Capture cross section [mb]	32.6	7.4	0.852
Compound Surv.Prob. (L=0)	5.13e-01	4.28e-01	3.45e-01
Compound formation CS [mb]	16.7	3.17	0.294
Compound-1stFission CS [mb]	12.9	2.47	0.232
Compound-Breakup CS [mb]	0	0	0

for setting residue after the stripper

Energy diapason [MeV/u] 0.135 :: 0.153  
 Corresponding ion charge state 18.62 :: 19.67

All fusion characteristics are calculated with BASS-model

Quit

16 14:13:51  
 ++ [G:\Dubna\SHELLSeff 48Ca Bi v5.lpp]

## Beam

The Beam configuration window includes the following sections:

- Beam energy:** Energy (4.609778 MeV/u), TKE (221 MeV), Brho (0.741896 Tm), P (4.4483 GeV/c), U (11050 KV).
- Beam intensity:** 20000 enA, 1000 pnA, 6.25e+12 pps, 0.22127 KW.
- Emittance (#1):** 1. X (5 mm, Ellipse uniform), 2. T (1 mrad, Gaussian), 3. Y (5 mm, Ellipse uniform), 4. P (1 mrad, Gaussian), 5. L (0 mm, Gaussian), 6. D (0.1 %, Gaussian).
- Other parameters:** Energy Loss in the target box (0.004403 KW), RF frequency (20 MHz), Bunch length (1 ns).

## Target

The Target configuration window for BiO2 includes the following sections:

- Material:** BiO2, Density (4.217 g/cm3), State (Solid).
- Dimensions:** mg/cm2 & micron, g/cm2 & mm.
- Thickness:** Thickness at 0 degrees (0.95802703 micron, 0.404 mg/cm2), Effective Thickness (0.95802703 micron, 0.404 mg/cm2).
- Other parameters:** Thickness defect, Absorbed Dose, d / Range (beam) (0.017), Energy Loss in the target box (0.00371 KW), Atoms / cm2 (3.03e+18).
- Calculations:** Use in Q-state calculations (checked).

209 Bi	0.35 mg/cm2
	1.01E+18 atoms
16 O	2.69E-02 mg/cm2
	1.01E+18 atoms
<b>BiO2</b>	<b>4.04E-01 mg/cm2</b>

## Stripper

The Stripper configuration window for Carbon (C) includes the following sections:

- Material:** C, Density (2.26 g/cm3), State (Solid).
- Dimensions:** mg/cm2 & micron, g/cm2 & mm.
- Thickness:** Thickness at 0 degrees (0.15486726 micron, 0.035 mg/cm2), Effective Thickness (0.15486726 micron, 0.035 mg/cm2).
- Other parameters:** Thickness defect, Atoms quantity / cm2 (1.75e+18).
- Calculations:** Use in Q-state calculations (checked).

Statistics

255Lr equil.charge distr-n after Stripper (C): Fragment energy = 0.1 MeV/u  
 48Ca (4.61 MeV/u) + BiO2 (0.4 mg/cm2)  
 Calculations for 255Lr 19+ 19+ 19+ 19+ 19+ ; Material C  
 Charge Distribution Method is 5  
 Plot 1

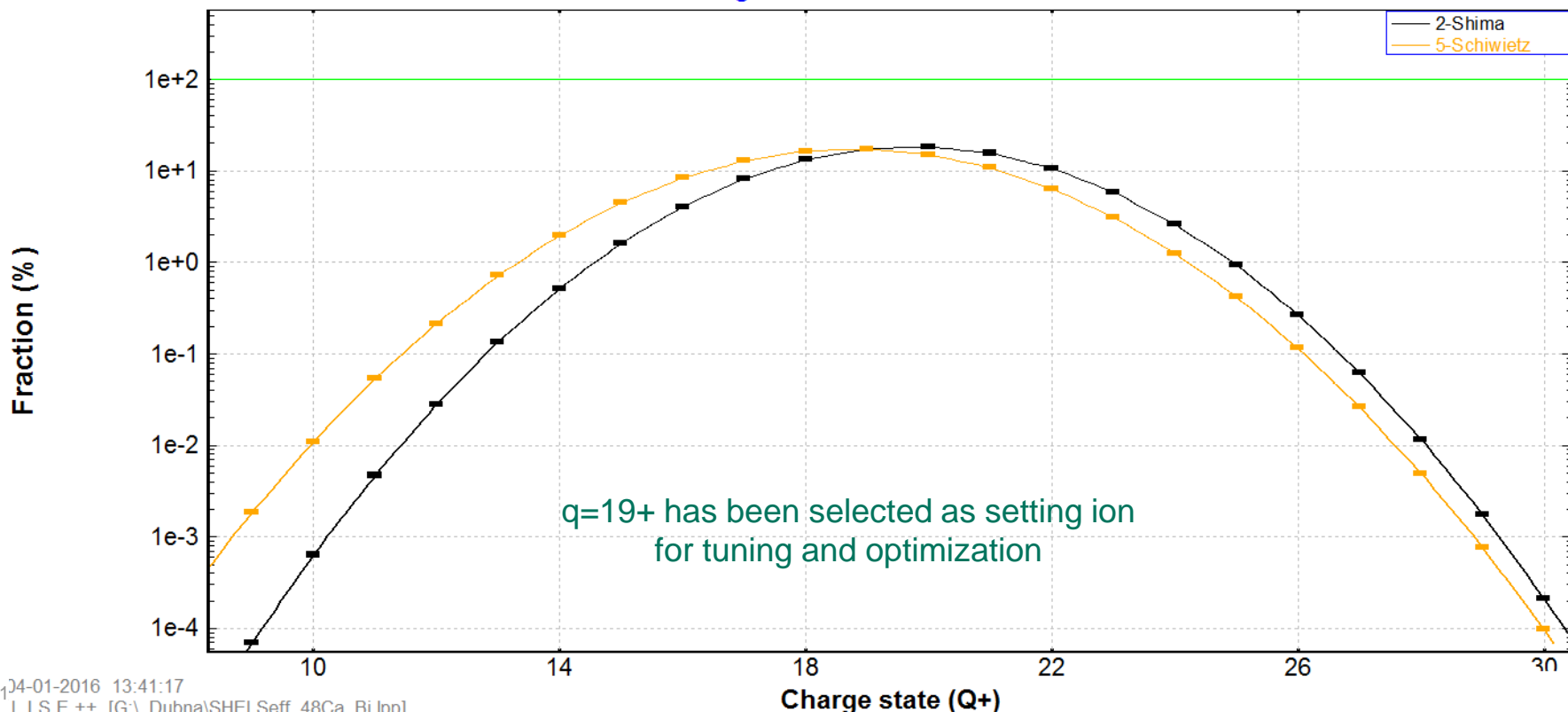
N	distribution	x-mean	x-max	y-max	deviation	FWHM	area	SumOfCounts	LeftPsigma	RightPsigma
01	0-Winger	+4.6582e+01	+4.7000e+01	1.962e+01	2.015e+00	4.777e+00	1.0000e+02	1.000e+02	2.309e+00	1.749e+00
02	1-Teon	+1.5138e+01	+1.5000e+01	2.858e+01	1.406e+00	3.315e+00	1.0000e+02	1.000e+02	1.338e+00	1.478e+00
03	2-Shima	+1.9748e+01	+2.0000e+01	1.843e+01	2.160e+00	5.115e+00	1.0000e+02	1.000e+02	2.350e+00	1.994e+00
04	3-GLOBAL+W	+4.6582e+01	+4.7000e+01	1.962e+01	2.015e+00	4.777e+00	1.0000e+02	1.000e+02	2.309e+00	1.749e+00
05	4-GLOBAL+I	+1.5138e+01	+1.5000e+01	2.858e+01	1.406e+00	3.315e+00	1.0000e+02	1.000e+02	1.338e+00	1.478e+00
06	5-Schwiertz	+1.8769e+01	+1.9000e+01	1.738e+01	2.293e+00	5.418e+00	1.0000e+02	1.000e+02	2.465e+00	2.136e+00

## 255Lr equil.charge distr-n after Stripper (C)

<sup>48</sup>Ca (4.61 MeV/u) + BiO2 (0.4 mg/cm<sup>2</sup>)

Calculations for 255Lr 19+ 19+ 19+ 19+ 19+ ; Material C

Charge Distribution Method is 5

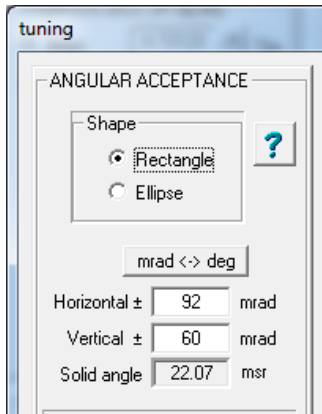


<b>Quadrupole_5</b>	<b>310mm</b> длина ярма	Вн. диаметр трубы в Q=188mm	<b>380mm</b> эффект.длина линзы	<b>7849</b>
Расстояние Q5-Q6	<b>270mm</b> Ярмо-ярмо	Внутр. диаметр трубы-188mm	<b>200mm</b> Эфф. границы Q5-Q6	<b>8049</b>
<b>Quadrupole_6</b>	<b>310mm</b> длина ярма	Вн. диаметр трубы в Q=188mm	<b>380mm</b> эффект.длина линзы	<b>8429</b>
Расстояние Q6-D8	<b>2115mm</b> ЯрмоQ6-ярмоD8	Внутр. диаметр трубы-188mm	<b>2036mm=(2115-35-44)</b> Эфф.гран.Q6 - эфф.гран D8	<b>10456</b>
<b>Dipole D8</b>	<b>500mm</b> длина ярма D8	$\Delta = 588\text{mm}-500\text{mm}=88\text{mm}$ $\Delta/2 = 44\text{mm}$ Диаметр отв. во фланцах камеры магнита D8 -148mm Угол поворота 7.3°	<b>588mm</b> эффект.длина D8	<b>11053</b>
D8-detector	<b>1558mm</b> ярмоD8- детектор	<i>Расстояние до детектора может варьироваться в зависимости от установленных детекторов</i>	<b>1514mm=(1558-44)</b> эфф.гран. D8 - детектор	<b>12567</b>
	Длина по железу <b>12541 mm</b>			Длина по траектории <b>12567 mm</b>

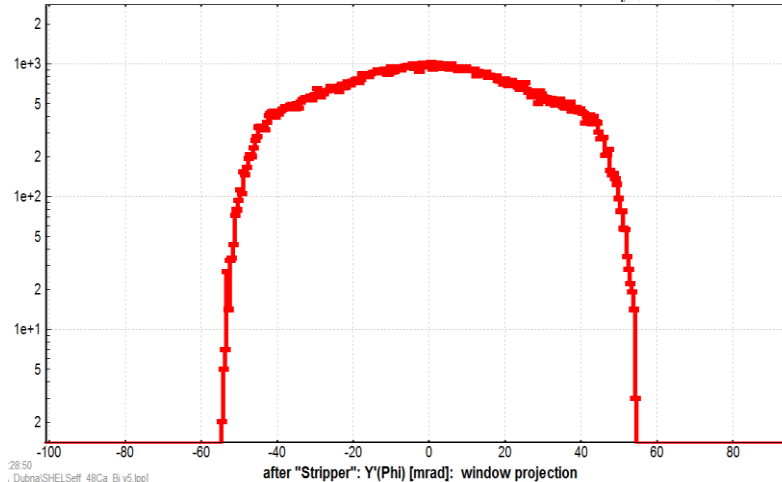
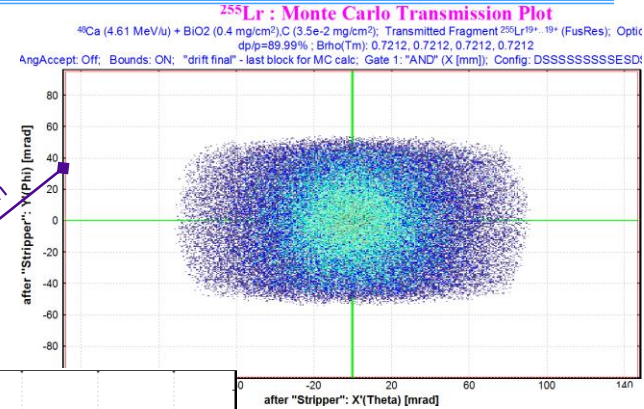
- Effective quad lengths have been fixed
- The geometry after D8 has been corrected

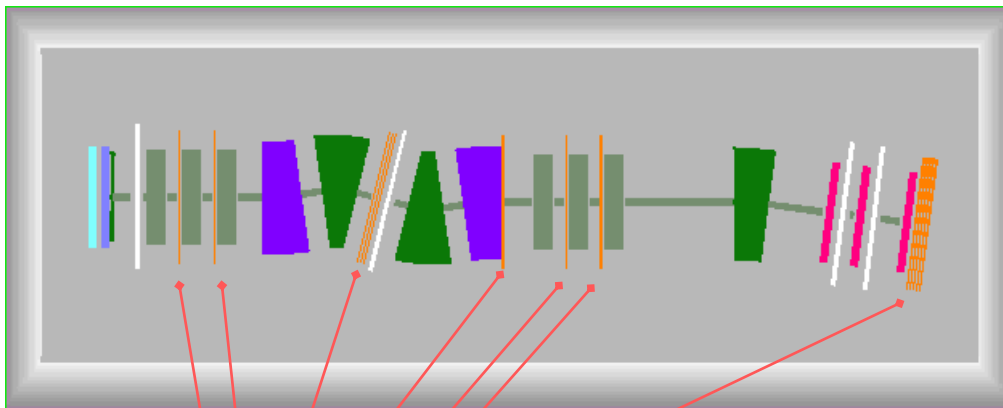
The Angular acceptance (used in the Distribution mode) vertical component has been modified based on MC transmission results after the optics optimization (will be discussed later).

New parameters give significantly better agreement between MC and analytical results

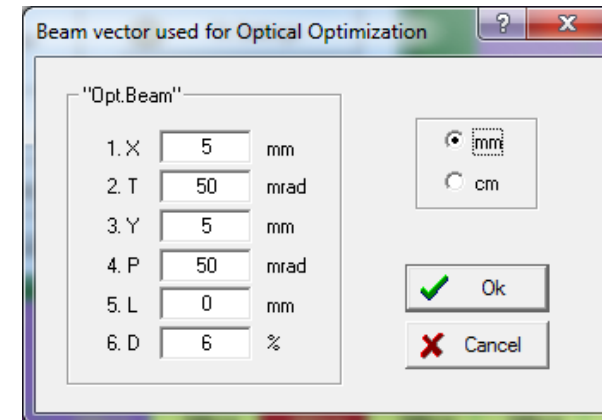


Previous values were 93 & 46

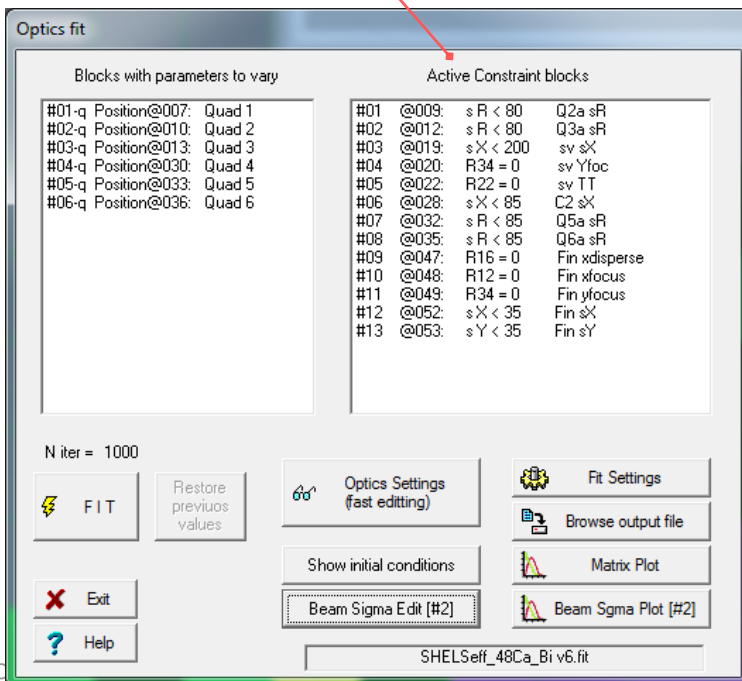




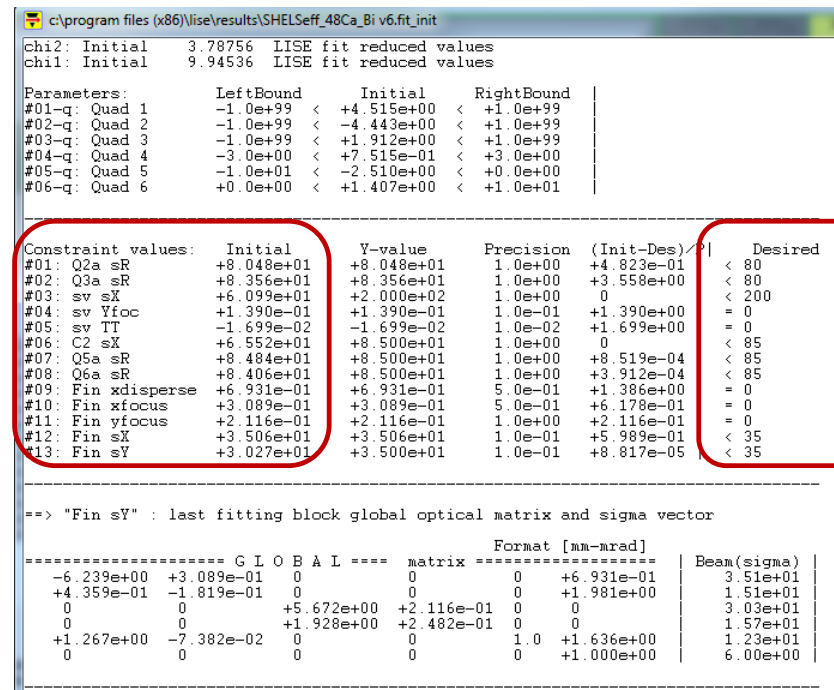
constraints



The beam emittance used for optimization was significantly increased



## RESULTS





Beam vector used for Optical Optim

"Opt.Beam"		
1. X	5	mm
2. T	50	mrاد
3. Y	5	mm
4. P	50	mrاد
5. L	0	mm
6. D	6	%

Due to large Y-spatial emittance

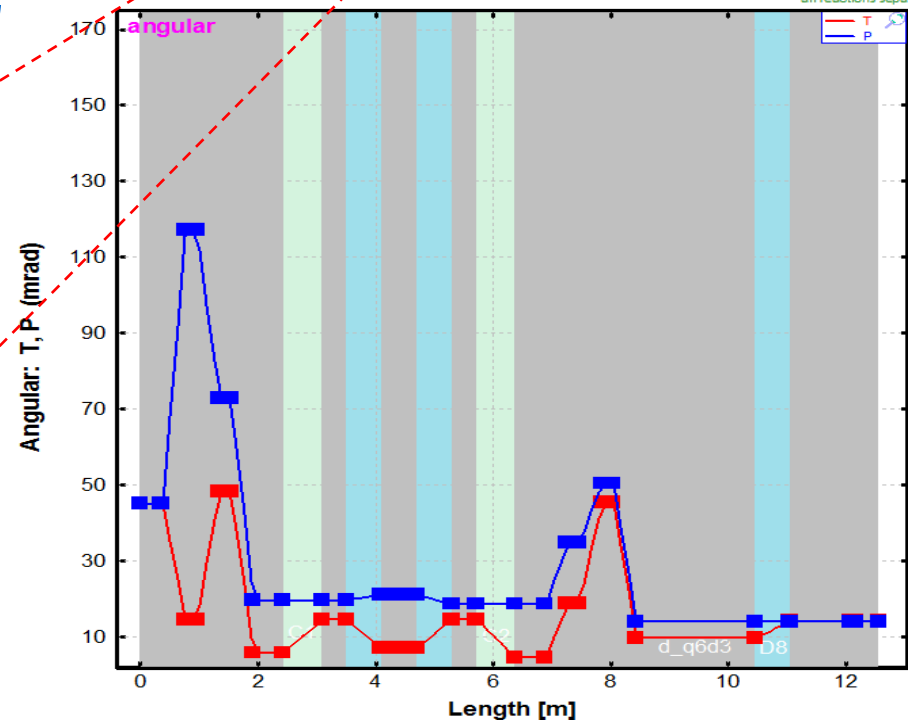
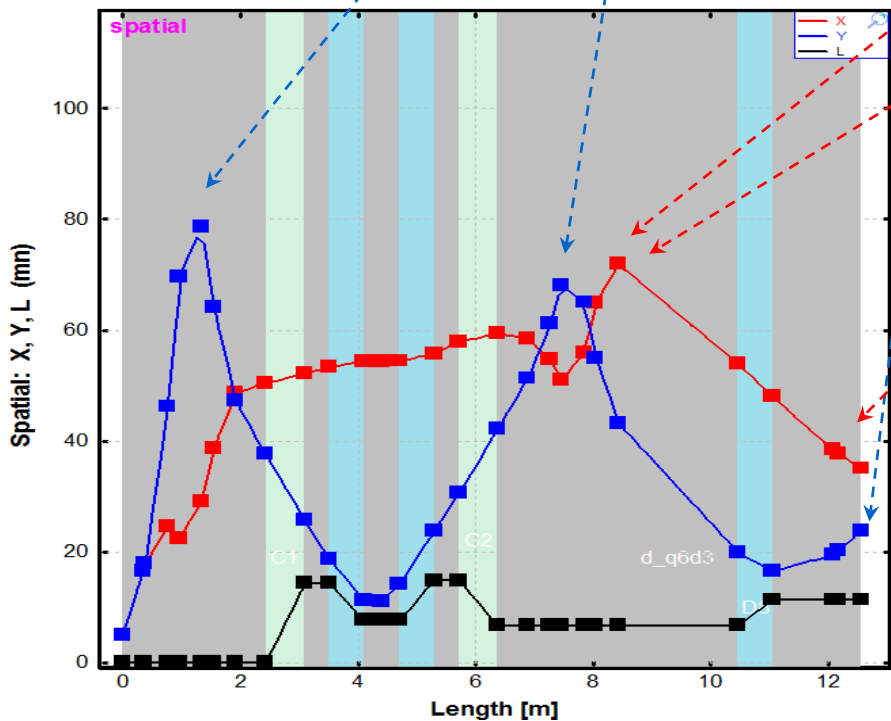
Due to large Y-angular emittance

Due to large X-angular emittance

Due to large X-spatial emittance

### Beam Sigmas [#2]

<sup>48</sup>Ca (4.61 MeV/u) + BiO2 (0,4 mg/cm<sup>2</sup>), C (3.5e-2 mg/cm<sup>2</sup>); Settings on <sup>255</sup>Lr<sup>19+..19+</sup>; Config: DSSSSSFSSFSSESDFSSFFSSDSEF...  
 dp/p=89.99% ; Brho(Tm): 0.7212, 0.7212, 0.7212  
 Optimization Beam Sigmas as used [#2]



all charge states sepa  
all reactions sepa

"Opt.Beam"

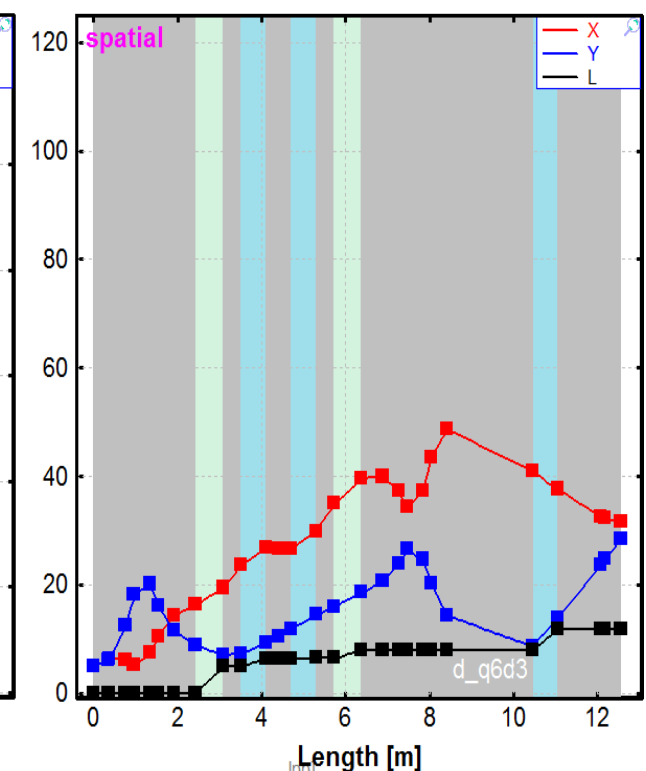
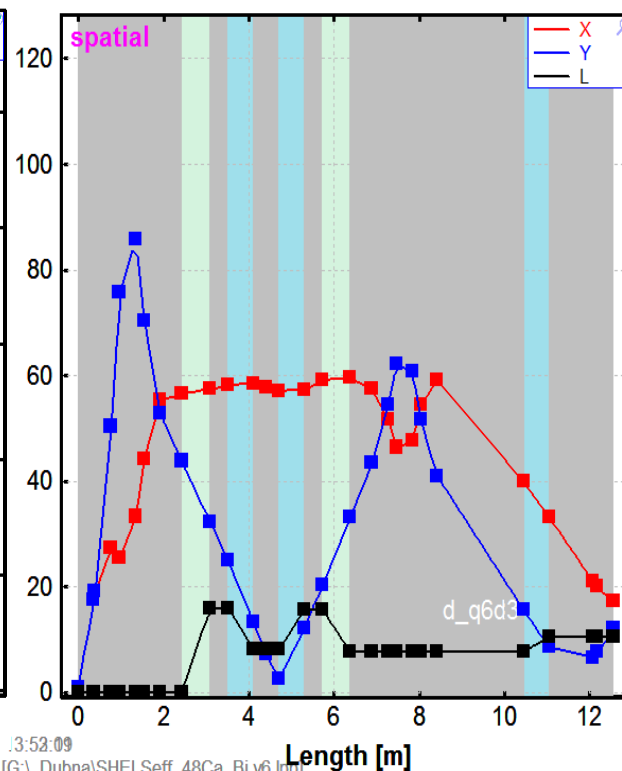
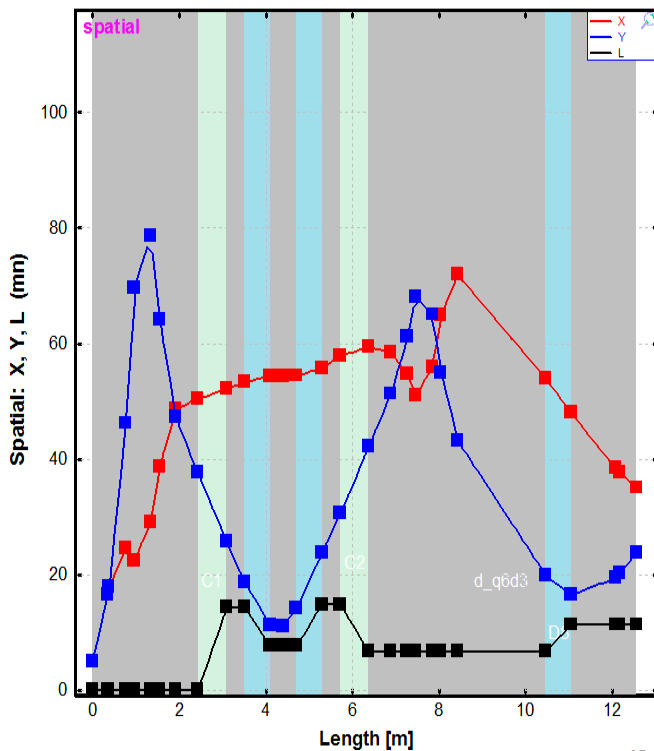
1. X	5	mm
2. T	50	mrاد
3. Y	5	mm
4. P	50	mrاد
5. L	0	mm
6. D	6	%

"Opt.Beam"

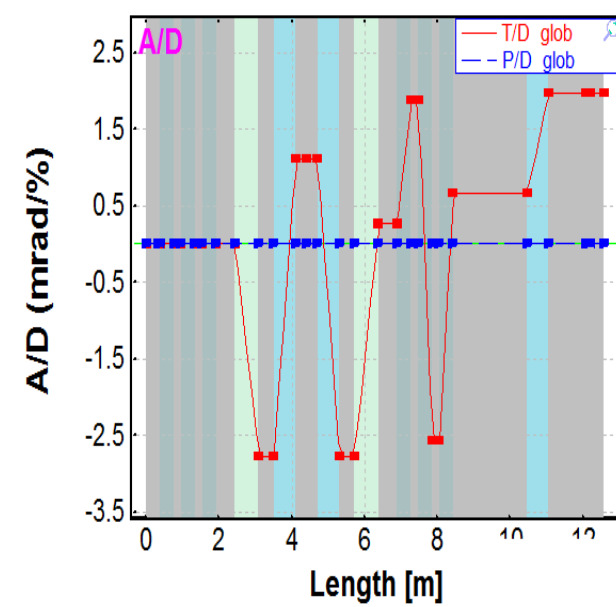
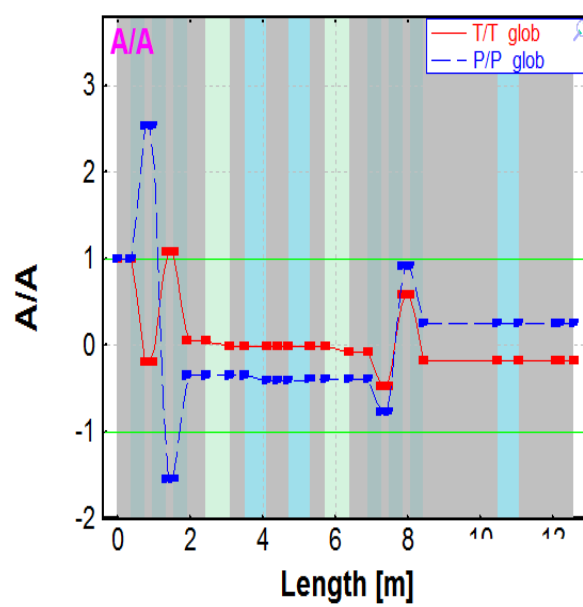
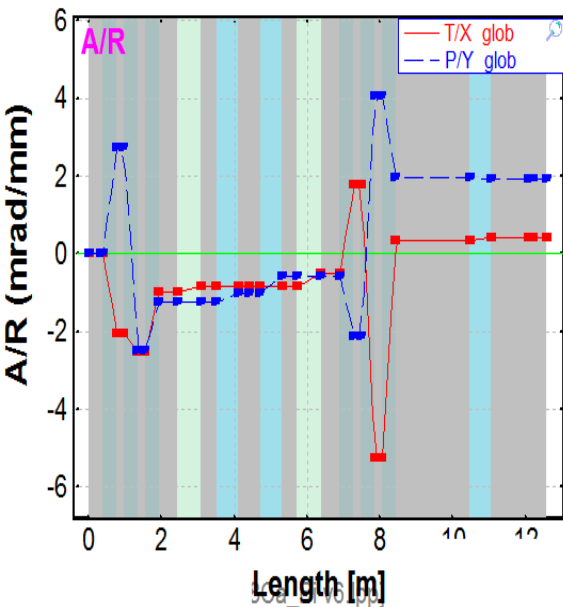
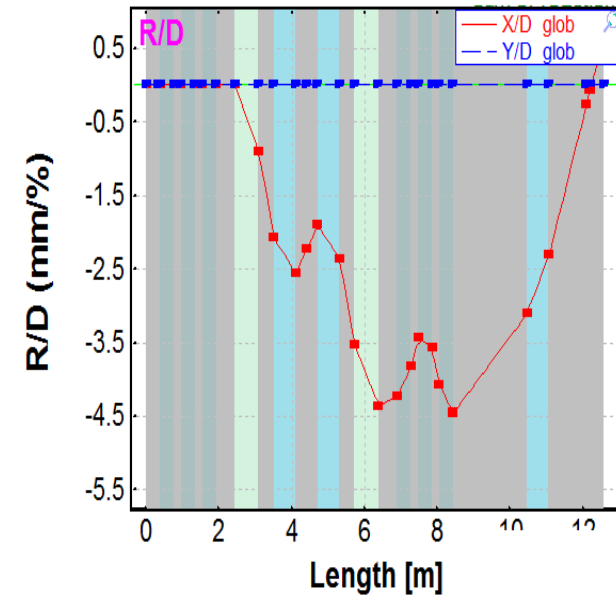
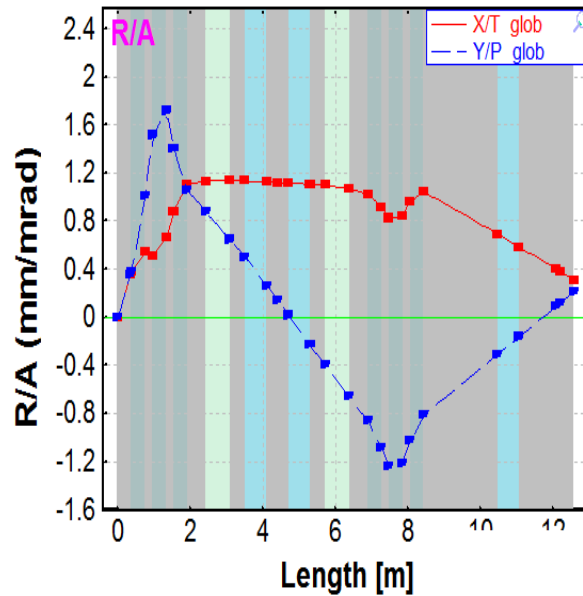
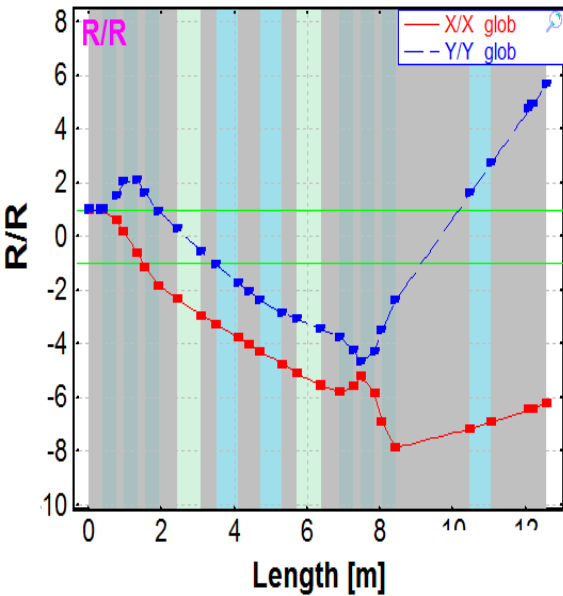
1. X	1	mm
2. T	50	mrاد
3. Y	1	mm
4. P	50	mrاد
5. L	0	mm
6. D	6	%

"Opt.Beam"

1. X	5	mm
2. T	10	mrاد
3. Y	5	mm
4. P	10	mrاد
5. L	0	mm
6. D	6	%

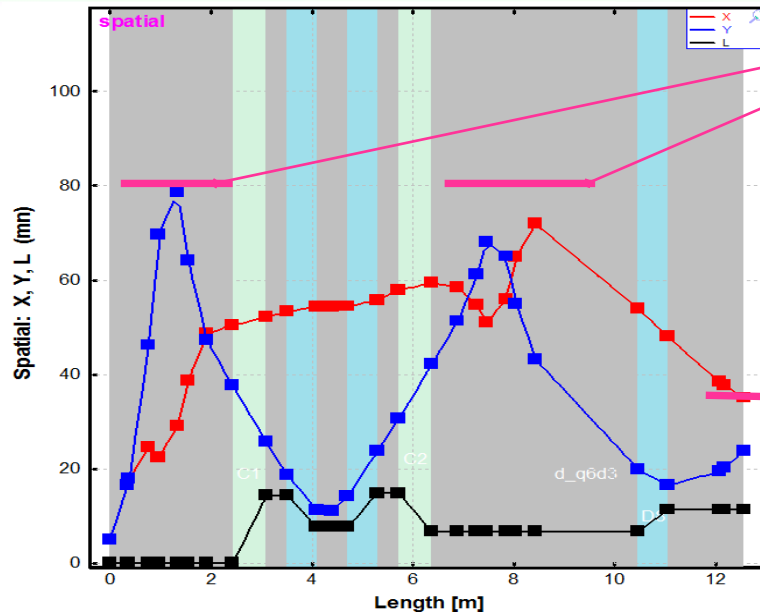


13:52:09  
 + IG:\Dubna\SHELSeff 48Ca Bi v6.tbl



"Opt.Beam"

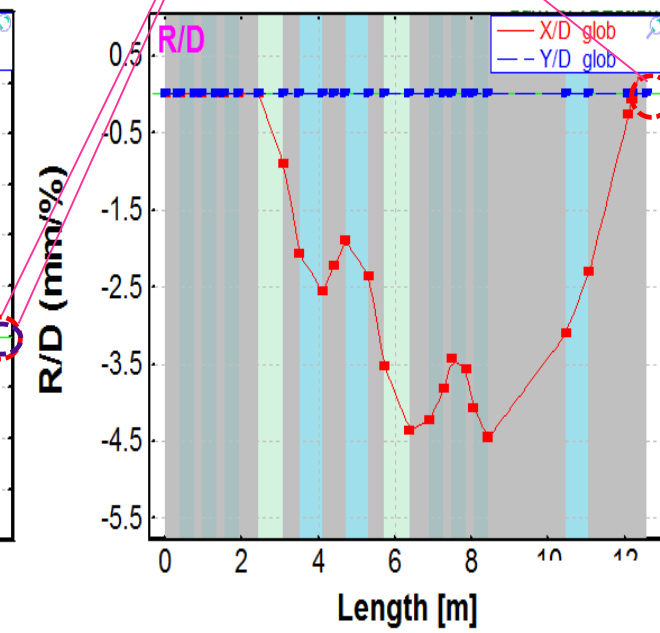
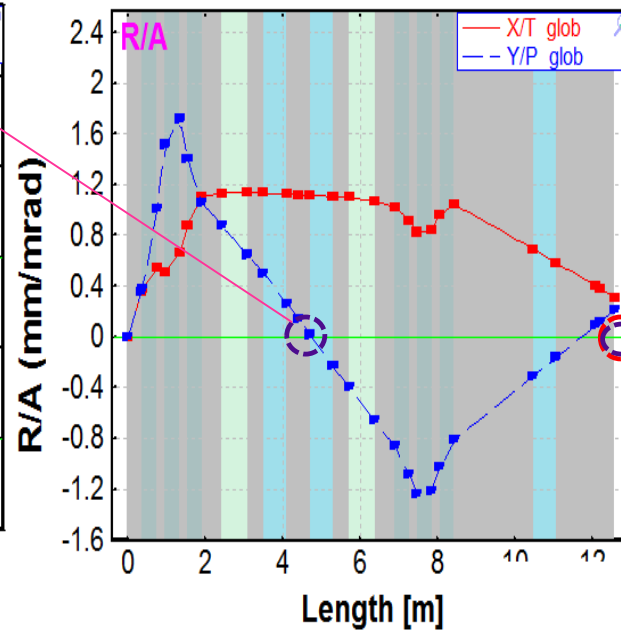
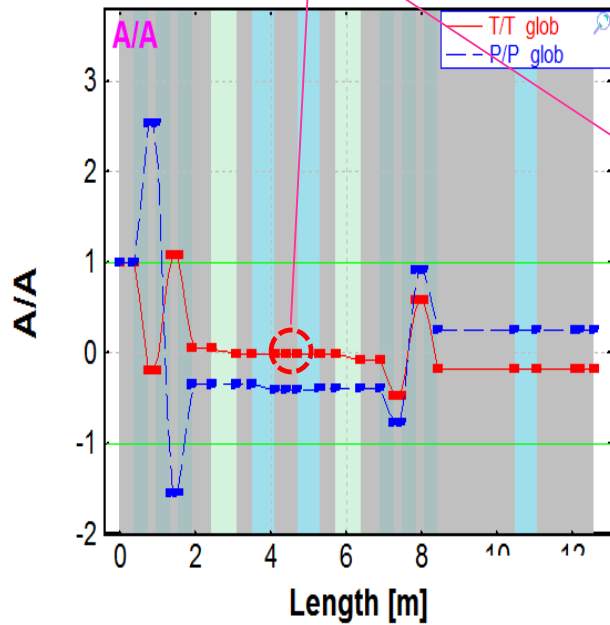
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3. Y	5	mm
4. P	50	mrad
5. L	0	mm
6. D	6	%



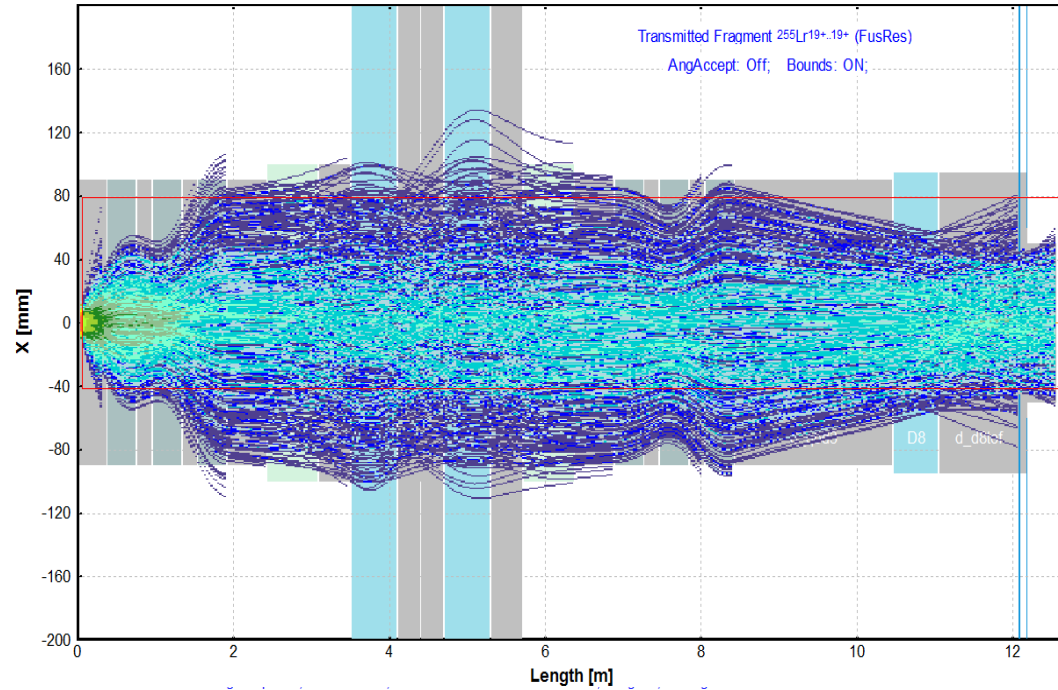
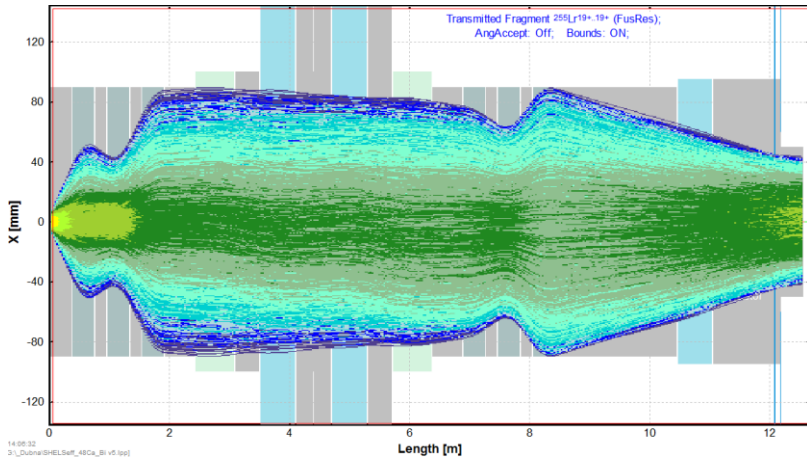
constraints

constraints

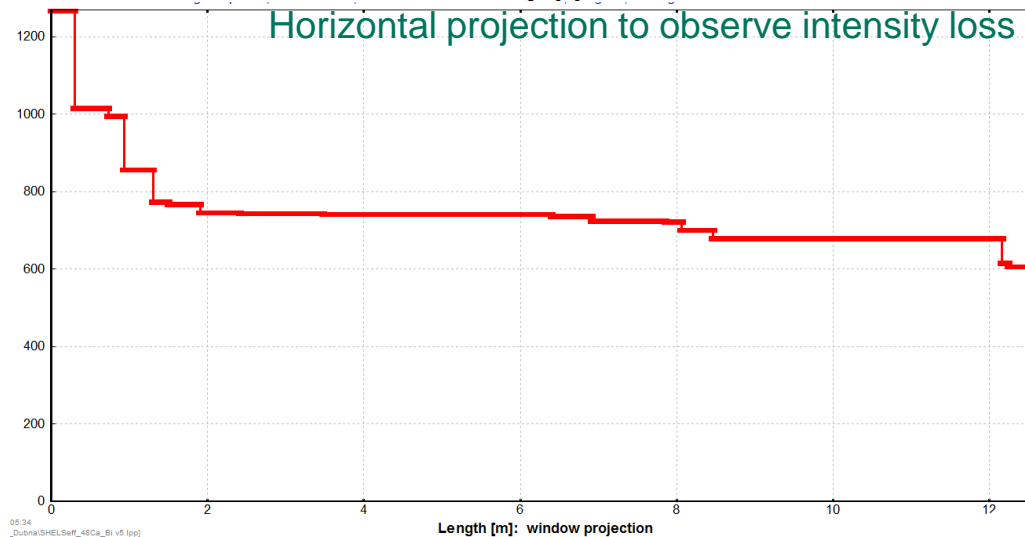
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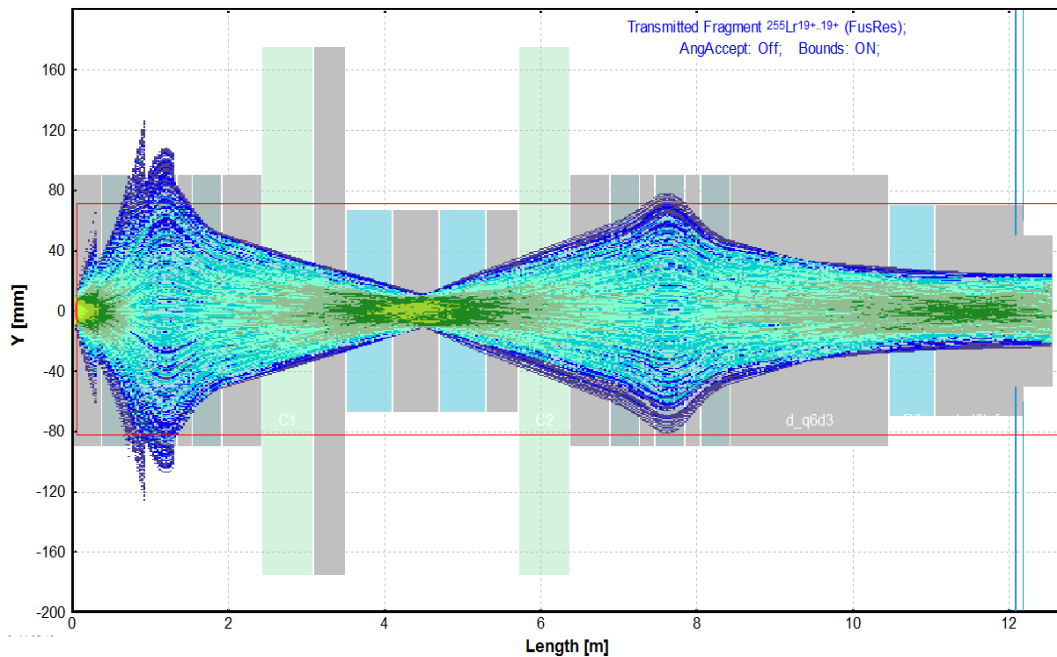
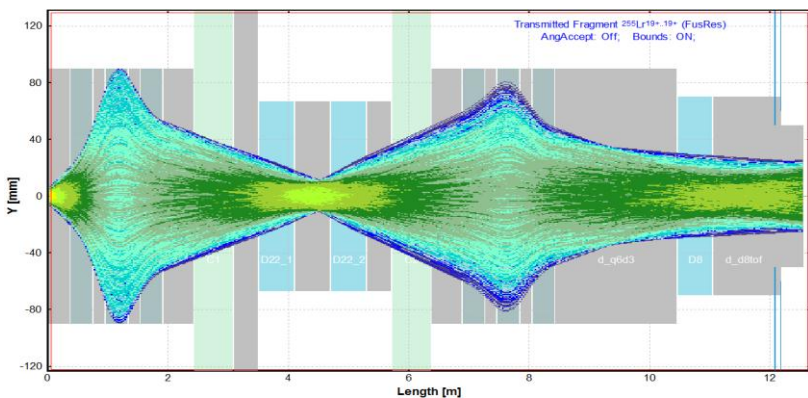
$^{255}\text{Lr}^{19+}$  transmission: 58.3%



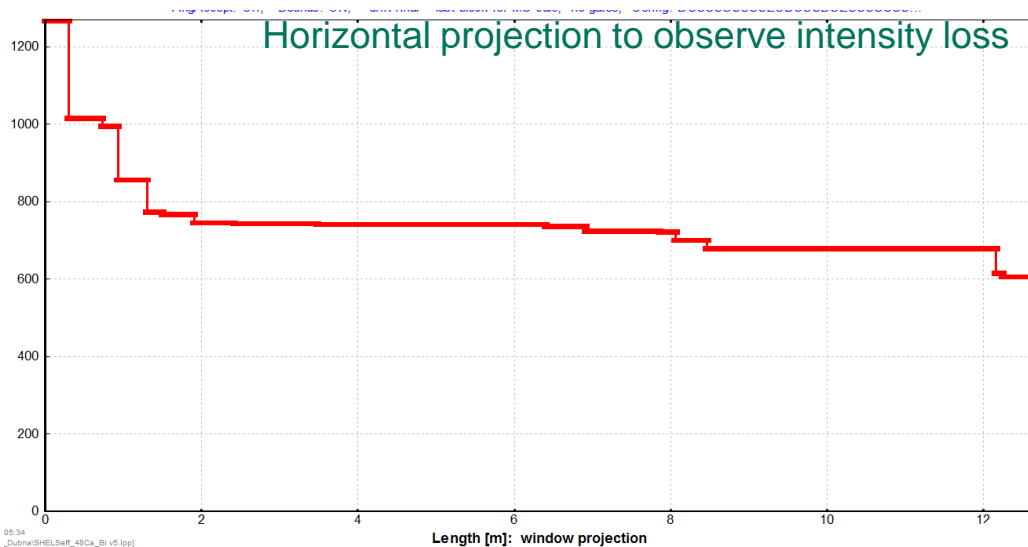
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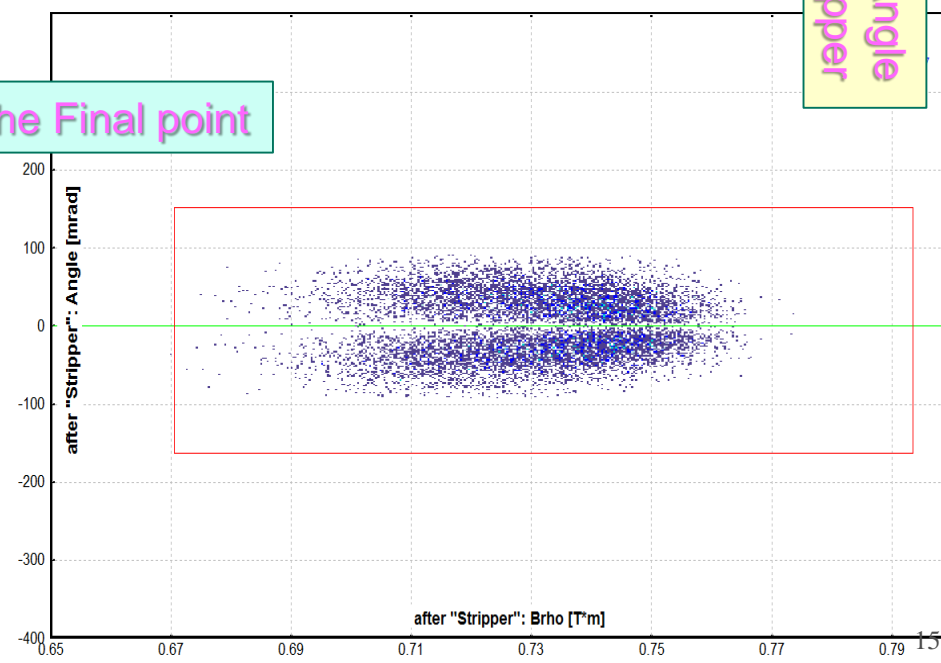
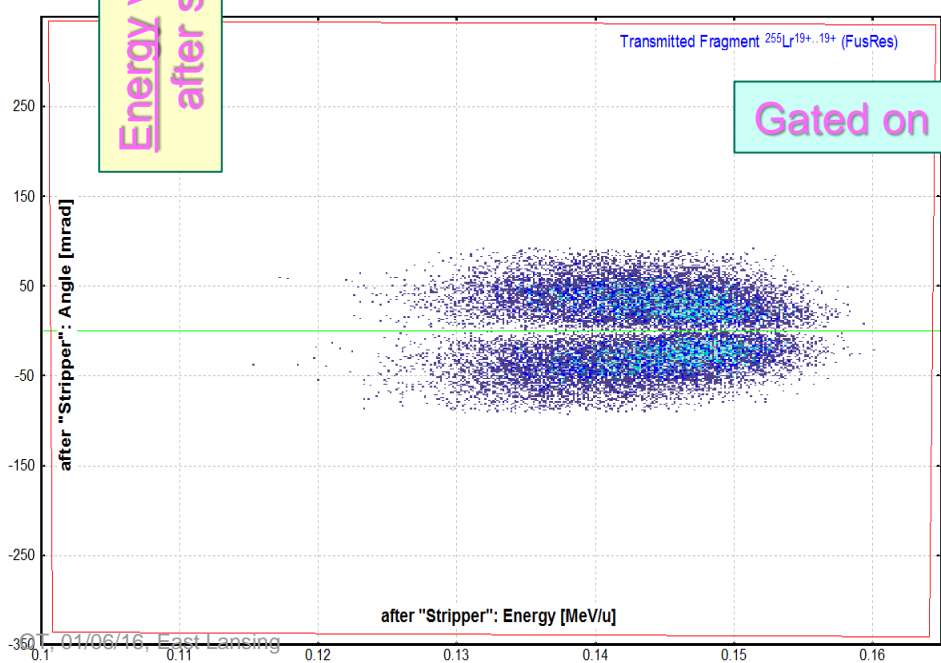
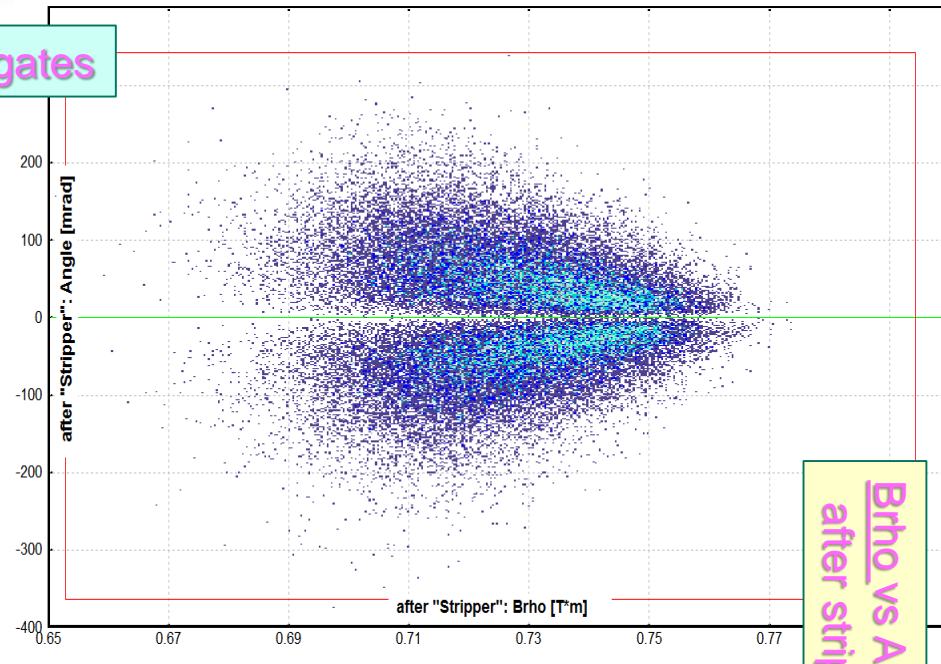
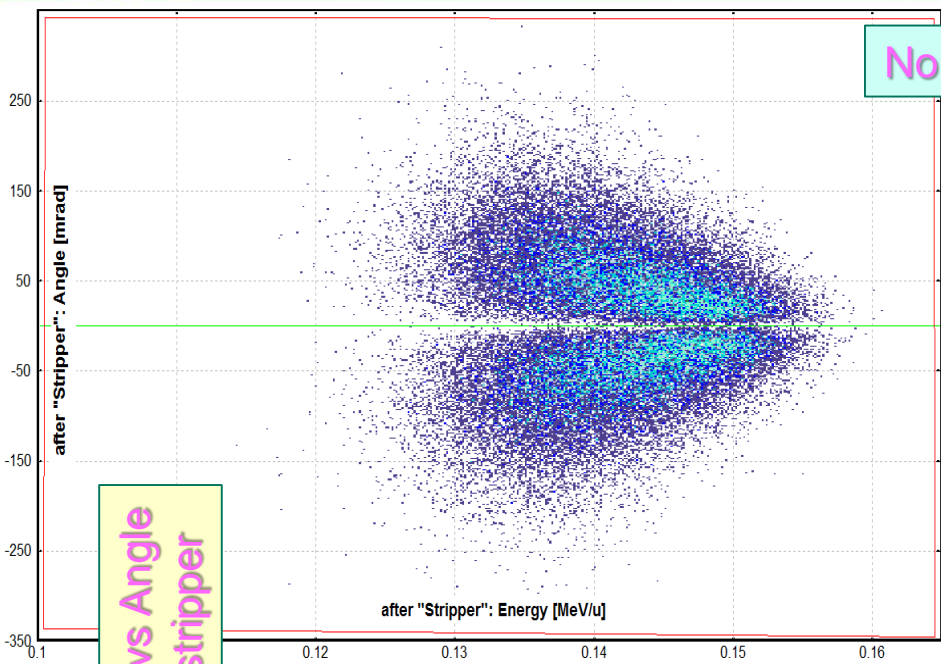


$^{255}\text{Lr}^{19+}$  transmission: 58.3%



Y



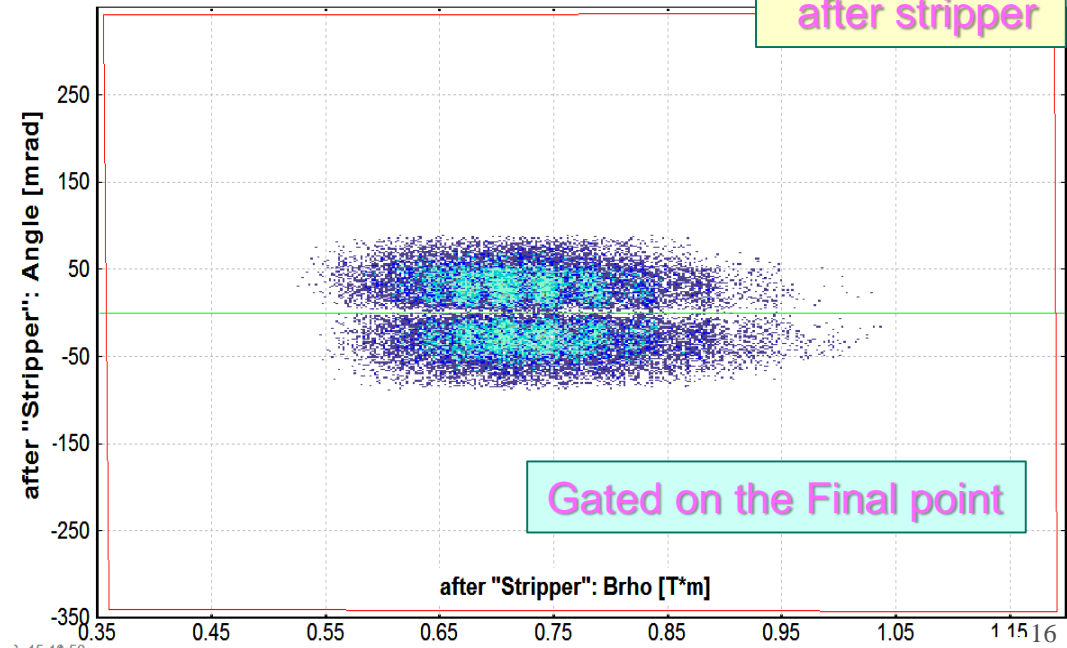
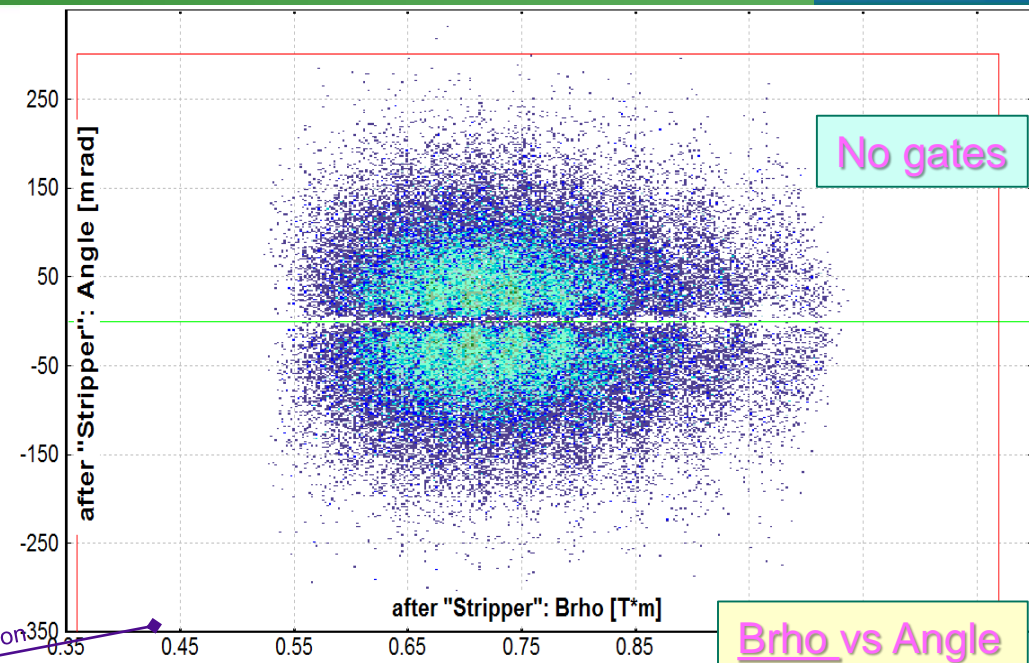
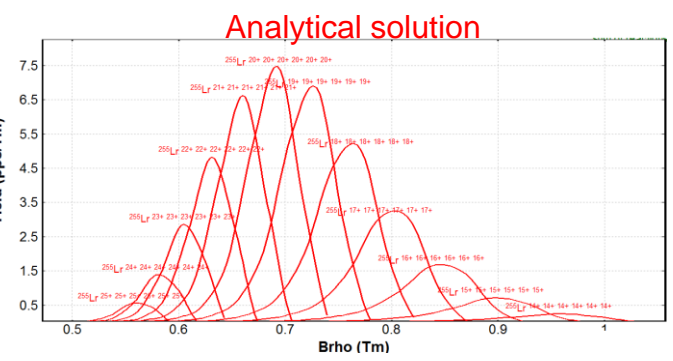
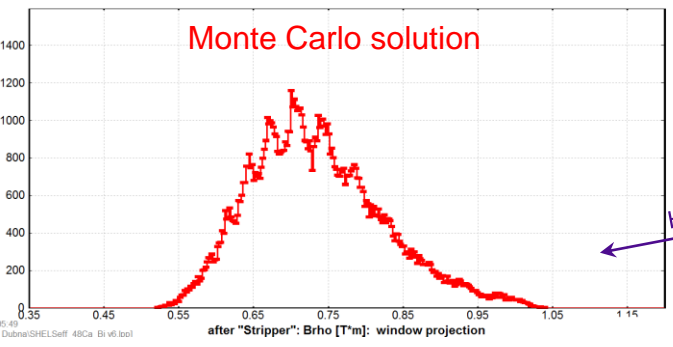


Energy vs Angle  
after stripper

Brho vs Angle  
after stripper

## $^{255}\text{Lr All+}$ transmission

Monte Carlo: 51.4%  
 Analytical: 44.7%



Horizontal projection

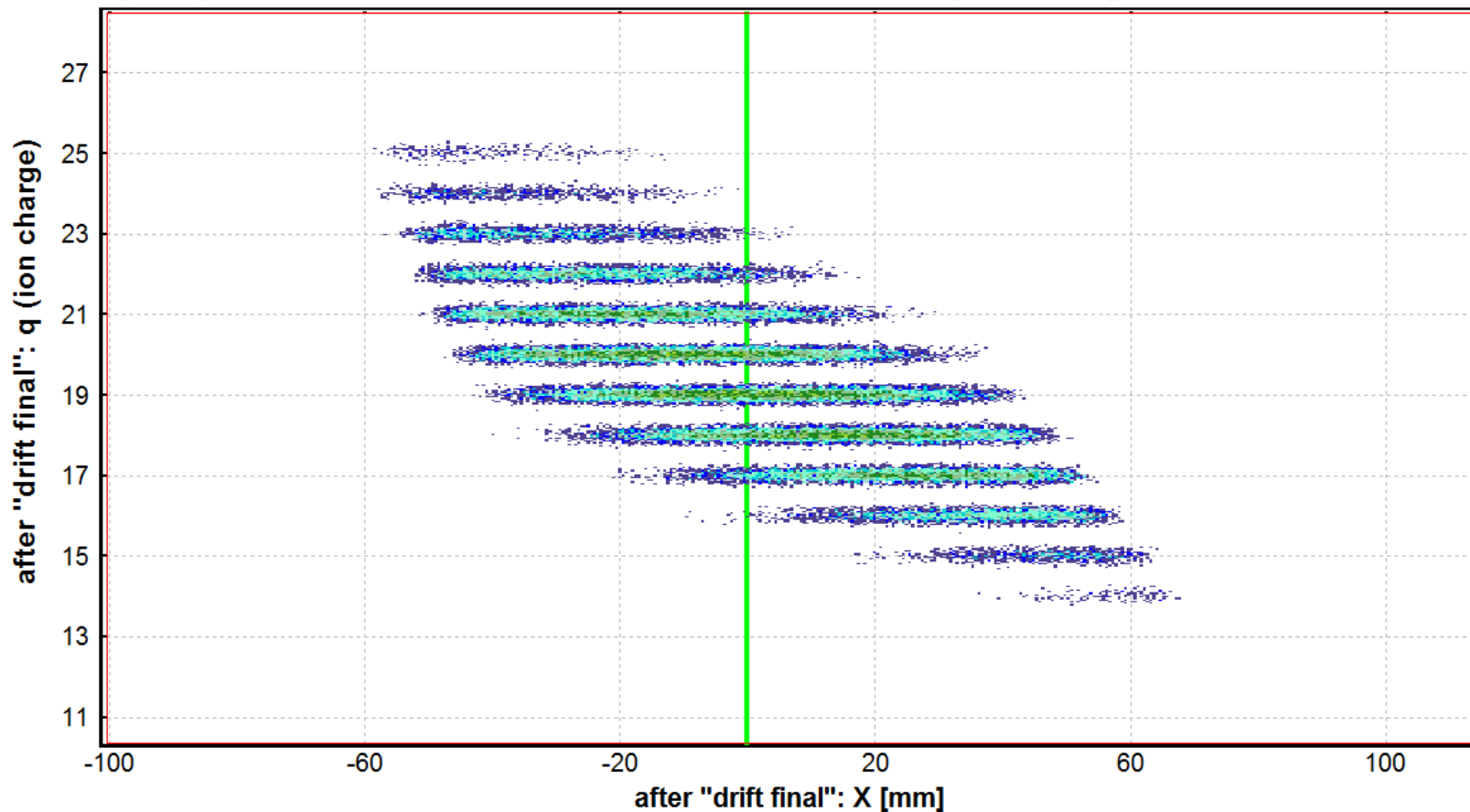
Brho vs Angle after stripper



## Isotope Group : Monte Carlo Yield Plot

$^{48}\text{Ca}$  (4.61 MeV/u) + BiO<sub>2</sub> (0.4 mg/cm<sup>2</sup>), C (3.5e-2 mg/cm<sup>2</sup>); Transmitted Fragment  $^{255}\text{Lr}^{19+..19+}$  (FusRes); Optic  
 dp/p=89.99% ; Brho(Tm): 0.7212, 0.7212, 0.7212, 0.7212

AngAccept: Off; Bounds: ON; "drift final" - last block for MC calc; no gates; Config: DSSSSSSSSSESDSSSDS



X vs ion charge @ Final point

$^{255}\text{Lr}^{\text{All+}}$  transmission Analytical : 44.7%

$^{255}\text{Lr}^{19+}$  transmission Analytical : 53.1%

statistics: 255Lr

255Lr      Alpha and Beta+ decay (Z=103, N=152)      Lawrencium

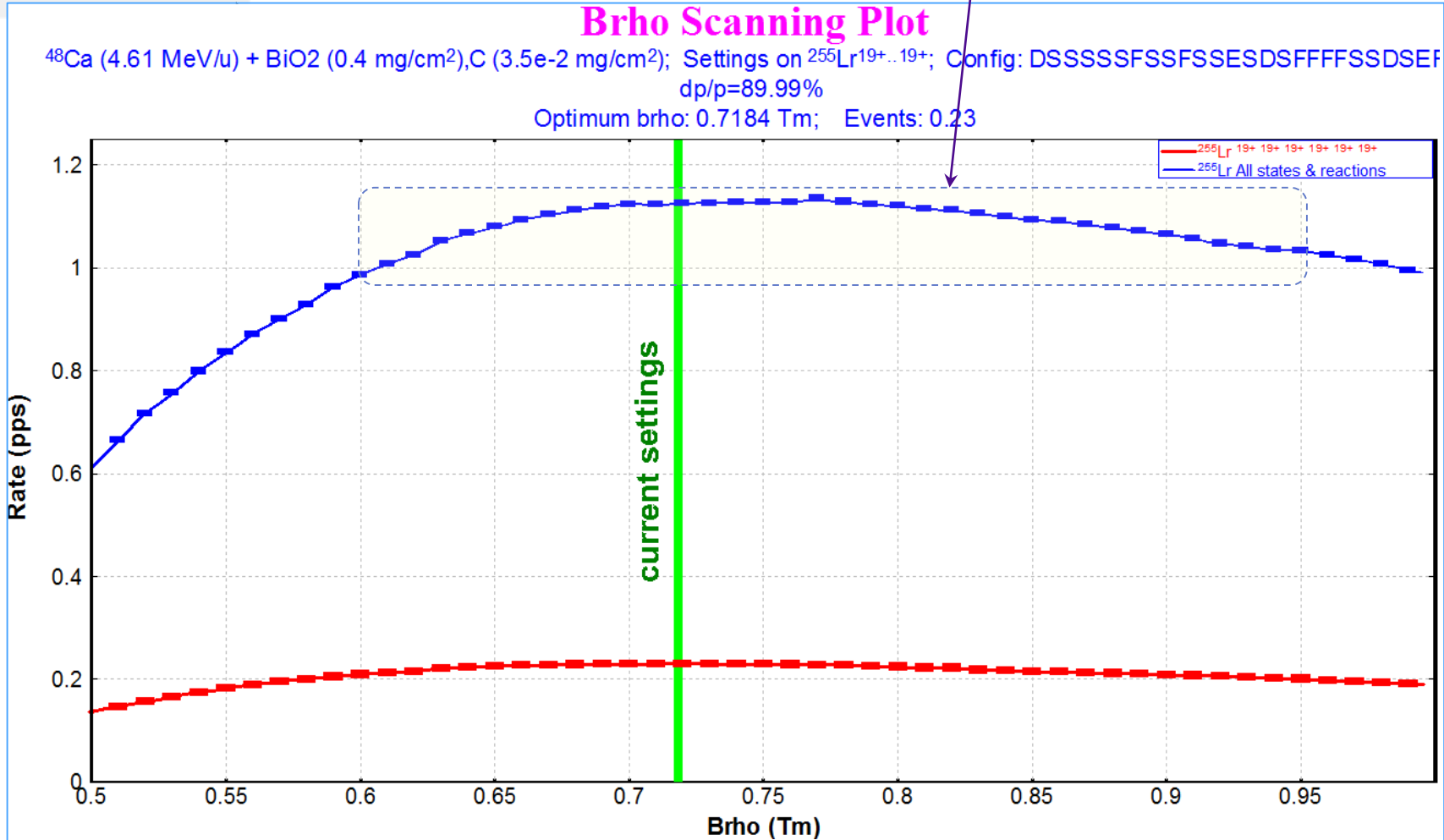
All reactions total isotope rate 1.19e+0 pps  
 and Overall isotope transmission 44.653 %

Reaction	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes
Q1(tuning)	25	24	23	22	21	20	19	18	17	16	15	14	
Q2(C1)	25	24	23	22	21	20	19	18	17	16	15	14	
Q3(D22_1)	25	24	23	22	21	20	19	18	17	16	15	14	
Q4(D22_2)	25	24	23	22	21	20	19	18	17	16	15	14	
Q5(C2)	25	24	23	22	21	20	19	18	17	16	15	14	
Q6(D8)	25	24	23	22	21	20	19	18	17	16	15	14	
<b>Ion Production Rate (pps)</b>	<b>6.1e-3</b>	<b>1.99e-2</b>	<b>4.92e-2</b>	<b>1.01e-1</b>	<b>1.67e-1</b>	<b>2.34e-1</b>	<b>2.45e-1</b>	<b>1.96e-1</b>	<b>1.1e-1</b>	<b>4.77e-2</b>	<b>1.44e-2</b>	<b>2.71e-3</b>	
Total ion transmission (%)	0.229	0.745	1.847	3.776	6.264	8.783	<b>9.098</b>	7.339	4.14	1.789	0.541	0.102	
Total: this reaction (pps)	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0	1.19e+0
X-Section in target (mb)	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4	1.41e-4
Target (%)	100	100	99.86	100	100	100	100	100	100	99.86	99.86	100	
Unreacted in material (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
Unstopped in material (%)	100	100	99.86	100	100	100	100	100	100	99.86	99.86	100	
Stripper (%)	0.874	2.31	5.05	9.12	13.58	16.77	17.15	14.47	10.09	5.82	2.76	1.09	
Unreacted in material (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
Q (Charge) ratio (%)	0.874	2.31	5.05	9.12	13.62	16.81	17.15	14.47	10.09	5.82	2.77	1.09	
Unstopped in material (%)	100	99.77	100	100	99.77	99.77	100	100	100	99.77	99.77	100	
tuning (%)	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4	61.4
X angular transmission (%)	88.45	88.45	88.45	88.45	88.45	88.45	88.45	88.45	88.45	88.45	88.45	88.45	88.45
Y angular transmission (%)	69.42	69.42	69.42	69.42	69.42	69.42	69.42	69.42	69.42	69.42	69.42	69.42	69.42
DTS1 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
slits 1 (%)	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75
X space transmission (%)	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75	99.75
Y space transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
DS1Q1 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
Quad 1 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
d_q12 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
Quad 2 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
d_q23 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
Quad 3 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
d_q3c1 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
C1 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
d_c1d1 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
D22_1 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
d_d1sv (%)	100	100	100	100	100	100	100	100	100	100	100	100	100
slits SV (%)	97.08	97.04	96.96	96.8	96.54	96.49	96.68	96.41	96.07	95.48	94.84	93.57	
X space transmission (%)	97.08	97.04	96.96	96.8	96.54	96.49	96.68	96.41	96.07	95.48	94.84	93.57	

9.098 / 17.15 \* 100%

- Calculations
- Utilities
- 1D-Plot
- 2D-Plot
- Databases
- Help
- Goodies
- Calibrations
- Transmission and rate
- Optimum Target
- Optimum Target-Wedge and Wedge-Wedge configurations
- Brho scanning**
- Optimum charge state combination
- Monte Carlo calculation of transmission
- Calculators

The small Brho shift does not affect on  $^{255}\text{Lr}$  yield due to very large momentum acceptance of the separator and broad momentum distribution of residues



## Angular Straggling & Rutherford scattering probabilities in compound

Utilities 1D-Plot 2D-Plot Databases Help

- LISE++ for Excel
- CODES : Charge, Global, PACE4, etc.
- Radioactivity, decays
- Reactions utilities**
  - Reaction's Characteristics
  - Angular Straggling & Rutherford scattering probabilities in compound**
  - Differential Cross Sections; LAB <-> CM converter
  - Electromagnetic excitation plots
  - Create an initial file for nucleon pick-up (beta)
- Plots : Energy loss, Ranges, Straggling, etc.
- NSCL / FRIB / ISOL rates
- NSCL / Europe / RIKEN primary beam lists

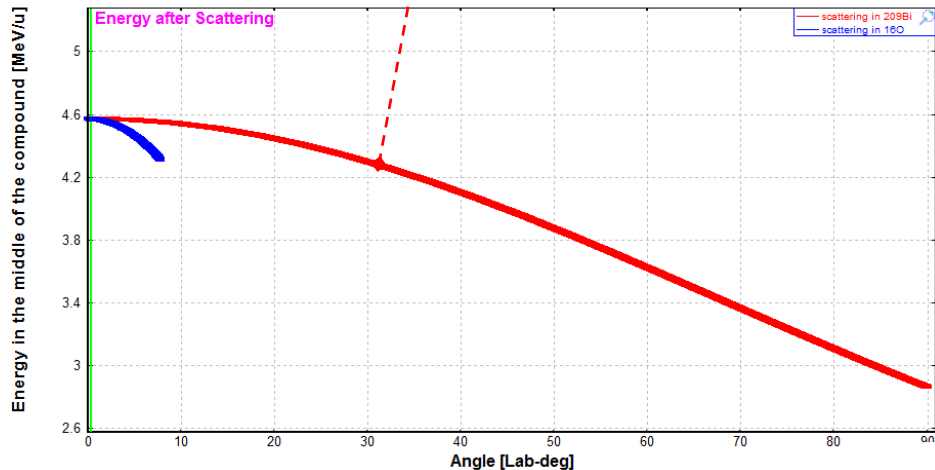
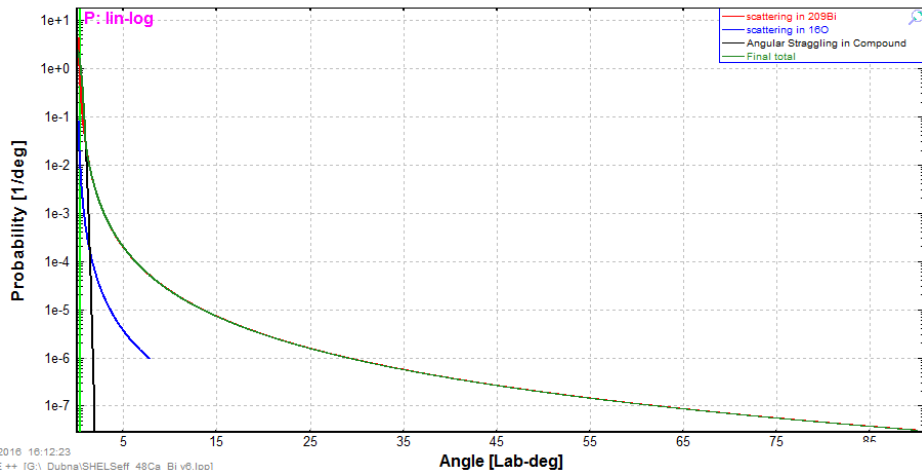
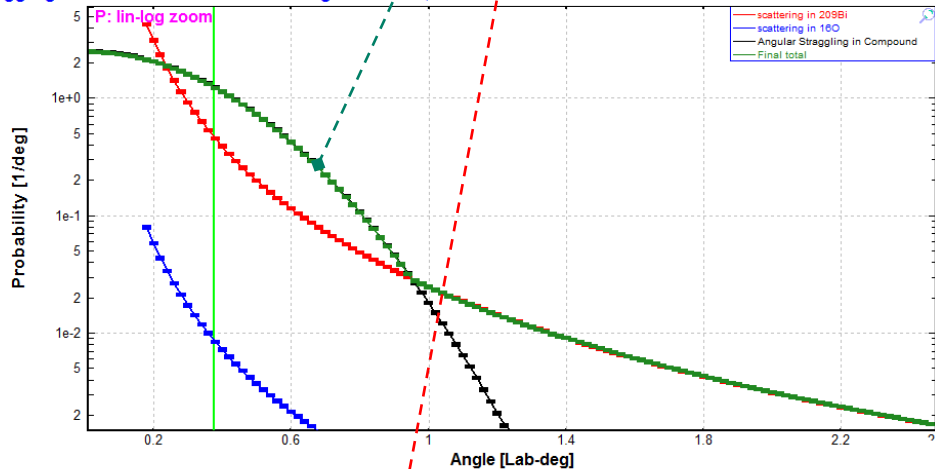
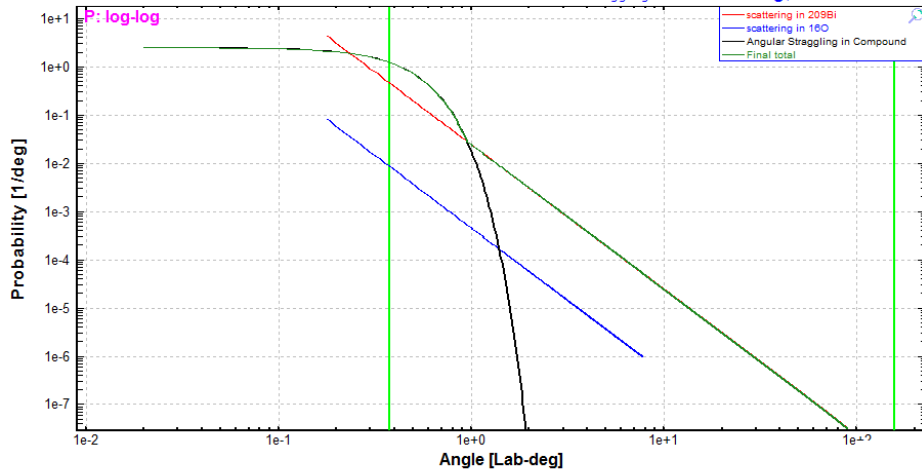
These  $P=f(\text{angle})$  and  $E=f(\text{angle})$  functions will be used in the Monte Carlo mode for the primary beam transmission calculations

### Angular Straggling & Rutherford scattering probabilities in compound

$^{48}\text{Ca}$  (4.61 MeV/u) + BiO2 (0.4 mg/cm<sup>2</sup>)

Grazing & maximum kinematic angles (in degrees) @ middle of material: [0]  $^{209}\text{Bi}$  : 156.9 & 180.00; [1]  $^{16}\text{O}$  : 7.8 & 19.48;

RMS<sub>straggling</sub><sup>space</sup> : 0.32 deg; Contribution: Straggling 99.3% & Rutherford scattering tail 0.69%; IRatio=1.007



Preferences

Starting files and working directories

Starting configuration at loading the program: A1900\_2015.lcn

Starting options file at loading the program: A1900\_2015.lopt

Working directory

Current user has administrative privileges:  Yes

LISE++ working directory (options, config, etc) is:  User \ My Documents  LISE++ root directory

Options dialogs

Target optimization options

Scheme options

Plot options

Calculation settings

Calculation threshold = 1.0e-10 pps

Calculate spectrometer settings using: maximal  mean

Apply the "Edge" effect in distribution cuts:  Yes (default)  No (It's recommended for extended configurations)

Dimension of distribution (NP): recommended

calculation WITHOUT charge states: 64  64

calculation WITH charge states: 32  32

wedge calculation: 32  16

Charge States Calculation: No  Yes

Cross Section: FR  File  CS File Settings

Transmission information in the Table of Nuclides

Display 1: Total: All reactions (pps)

Display 2: Total ion transmission (%)

Utility options

Primary beam scattering in target (MC)

Navigation map

Spectrometer scheme

Sound

3D-Balls Animation

Debug & expert options

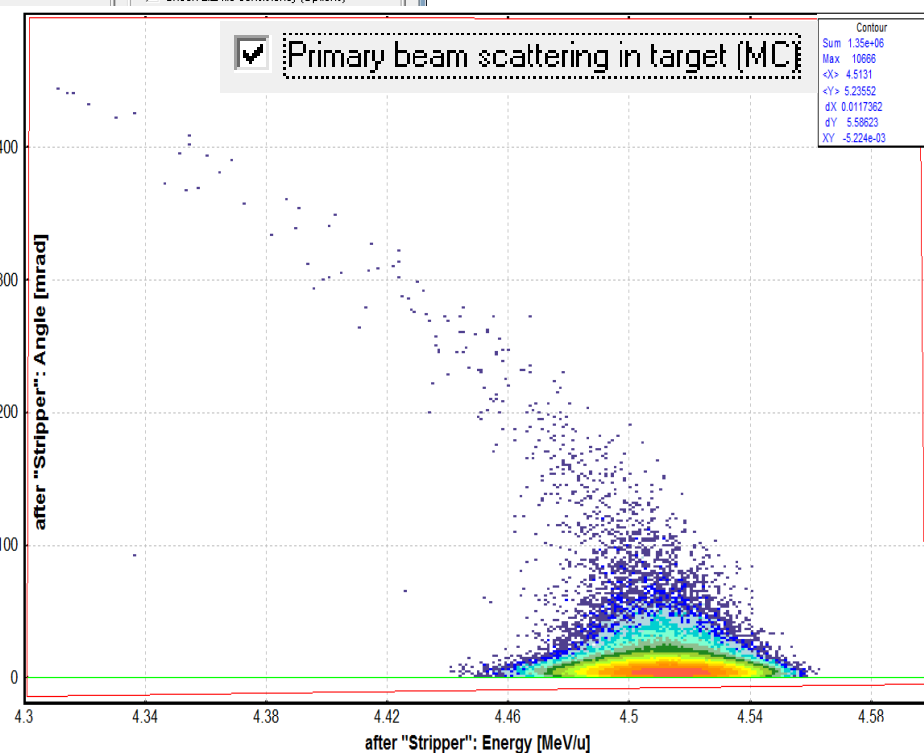
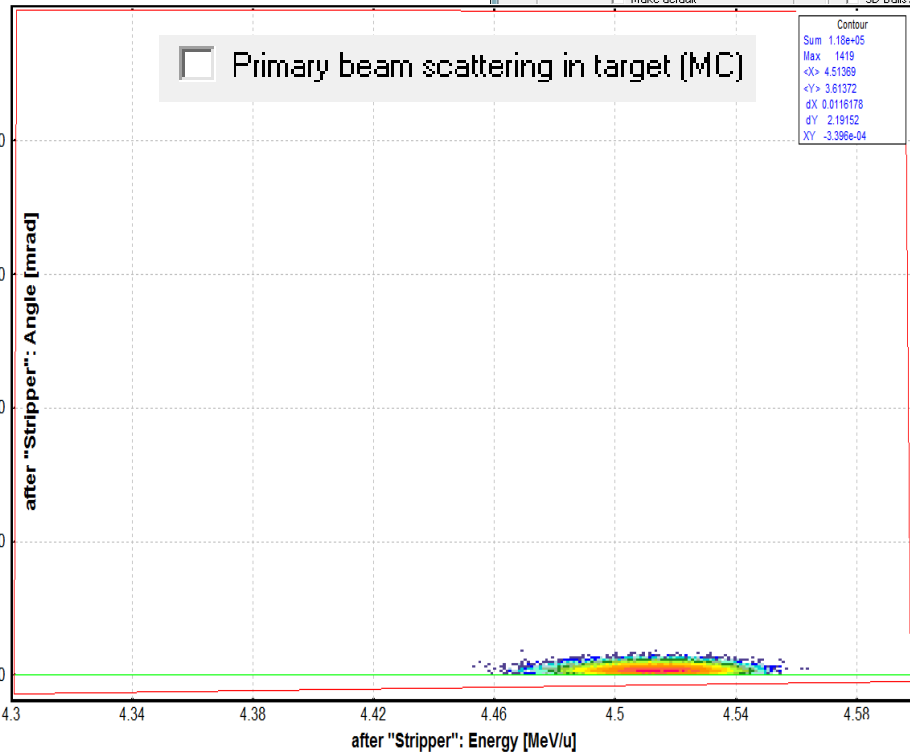
Show transmission calculation time

Charge State Optimization Debugging Mode

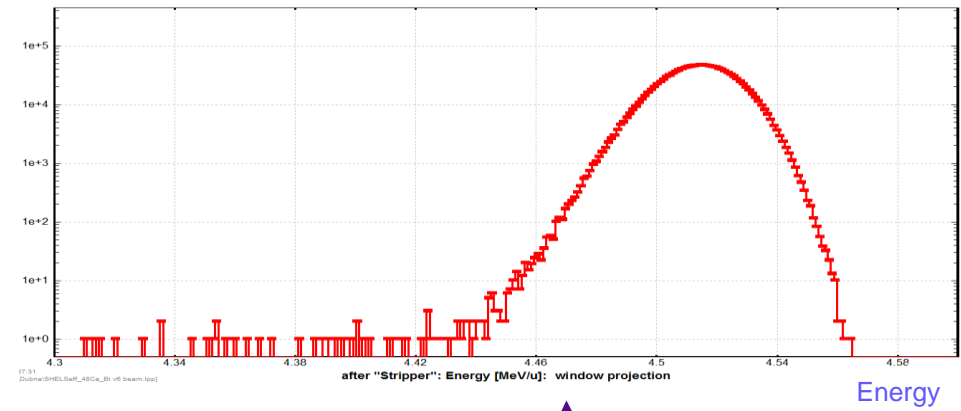
Distribution Debugging Mode (file 'distrib.txt')

Check LIZ-file consistency (Configurations)

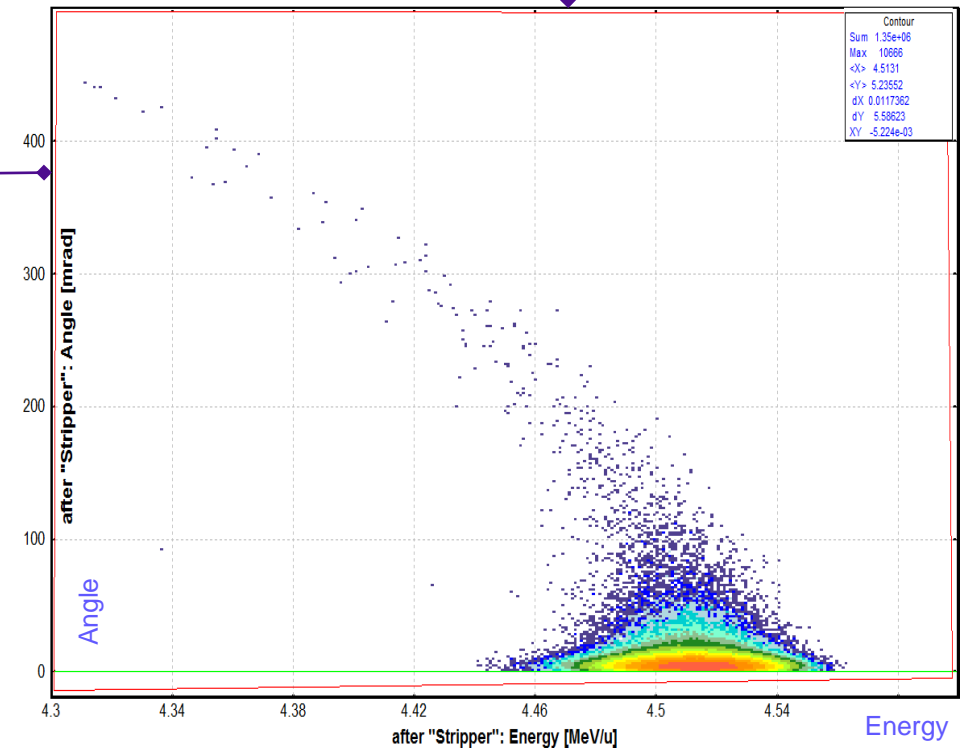
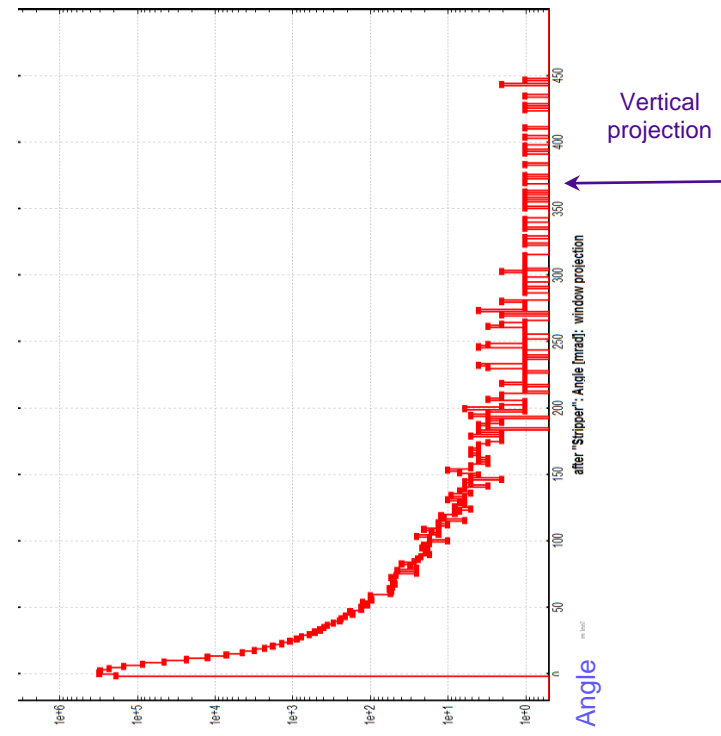
Check LIZ-file consistency (Options)



Primary beam scattering in target (MC)



Horizontal projection



**MC transmission options**

High Order Optics Calculations 2

Use in calculations :  through 3rd order    Highest Order in this configuration: 1

only 1-st order     through 4th order

through 2nd order     through 5th order

for the Isotope group case only

X-sections independent calculations (all cross sections equal)

Straggling in material

Angular

Energy

Lateral \*\*

Detector resolution

Use energy and time resolution of detectors for TOF, Energy loss, and TKE values

Use spatial resolution of detectors for X and Y values

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]

only for the ENVELOPE mode

Show trajectories of all fragments (including unselected by fragment-separator)

XY orientation

"Absolute" -> Laboratory frame

"Local" -> Follow Rotation blocks

Width to plot Integer Values (A,Z,q ...)

X - sigma = 0.1    0.001 < Sigma < 0.5 default 0.1

Y - sigma = 0.1

Take into account thickness defect of materials

Take into account losses due to reactions in materials

Include charge state calculations in the total transmission \*\* time consumed option

Assume the reaction takes place at the middle of target

for Angular distributions    \* these two distributions are correlated for fusion and fission reactions

for Momentum distributions

Options for the "Input file of ion rays" mode

Recycle input reading file

Use standard deviations from the file

Make default

OK

Cancel

Help

"Radial" & "Angular" values sign

Always positive value

Use X-coordinate sign

**Monte Carlo calculation of fragment transmission**

What isotope transmission to calculate? 1

One fragment of interest. Chose manually here

Group of Isotopes already calculated by the Distribution method [Ncalc = 12]

List of isotopes from file to produce inside target 2 **48ca\_beam: 13**

Input ions rays from file emitted from target -- no file --

Chose fragment of interest

A	Element	Z
255	Lr	103

Charge states: 19+ tuning    Set

Reaction mechanism: Fusion -> Residual

MC transmission options 3

**List of isotopes from file to produce inside target**

Open file    View file    Clear

Save isotopes calculated by the Distr.Method to file

48ca\_beam.listiso

Rows = 13    OK    Cancel

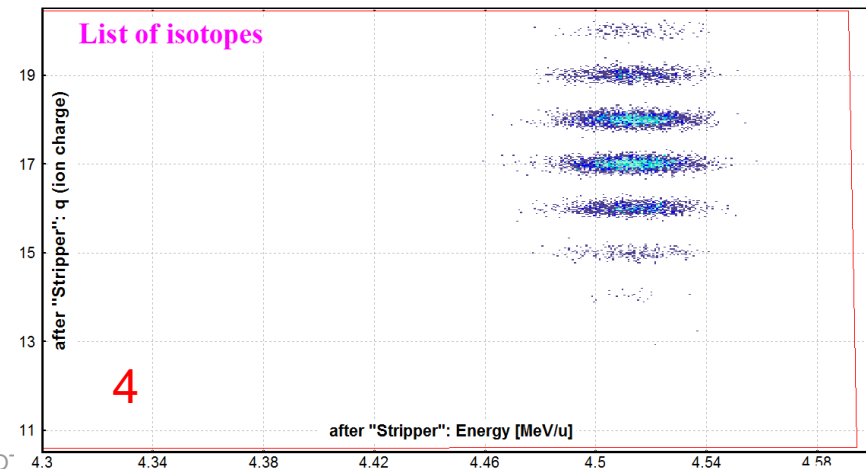
Note

The Isotope list file is in ASCII format. Comment string begin with "!" or ";"

The Columns can be separated by a Space, a Comma or a Tabulation. User can put comments after the data.

There are three first columns: "Z", "N", "R#" where Z is atomic number, N is number of neutrons. R# - reaction order number; 0 is PF, 1 is FR, 2 is FF ...

Next columns are Charge states 3

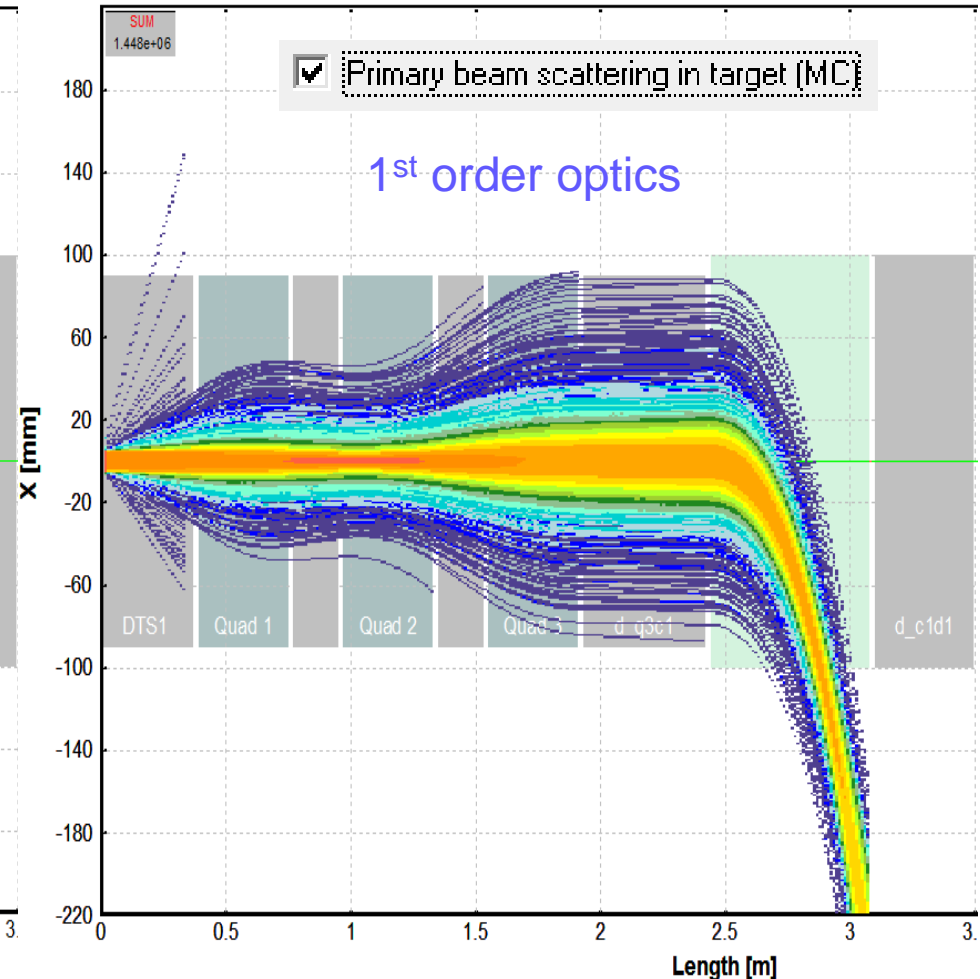
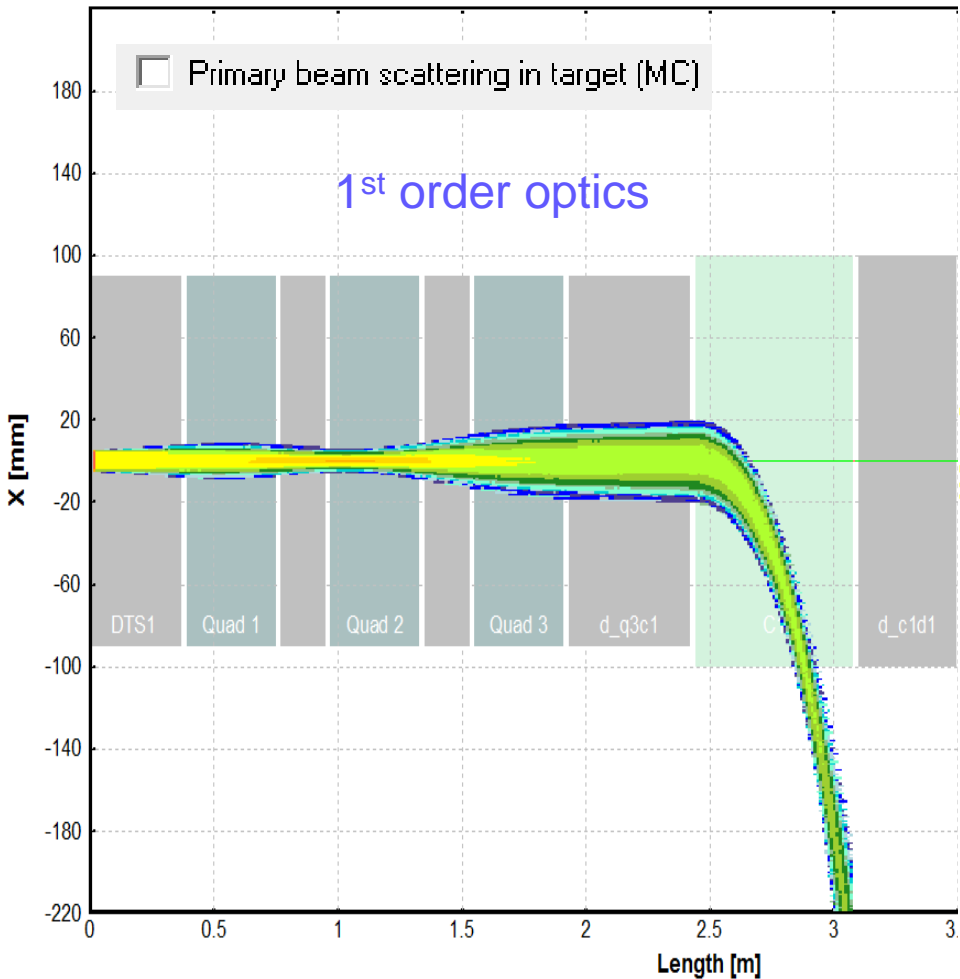


GA\_Dubna2016\_01\_04\_Dubna48ca\_beam.listiso

Z	N	Reaction	Q1	Q2					
20	28	R0	20+	20+	20+	20+	20+	20+	20+
20	28	R0	19+	19+	19+	19+	19+	19+	19+
20	28	R0	18+	18+	18+	18+	18+	18+	18+
20	28	R0	17+	17+	17+	17+	17+	17+	17+
20	28	R0	16+	16+	16+	16+	16+	16+	16+
20	28	R0	15+	15+	15+	15+	15+	15+	15+
20	28	R0	14+	14+	14+	14+	14+	14+	14+
20	28	R0	13+	13+	13+	13+	13+	13+	13+
20	28	R0	12+	12+	12+	12+	12+	12+	12+
20	28	R0	11+	11+	11+	11+	11+	11+	11+
20	28	R0	10+	10+	10+	10+	10+	10+	10+
20	28	R0	9+	9+	9+	9+	9+	9+	9+
20	28	R0	8+	8+	8+	8+	8+	8+	8+

**2<sup>nd</sup> order optics** has to be used  
for primary beam charge states transmission !!!!!

It will be done soon (Electrical dipole).





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for primary beam charge states transmission !!!!!

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