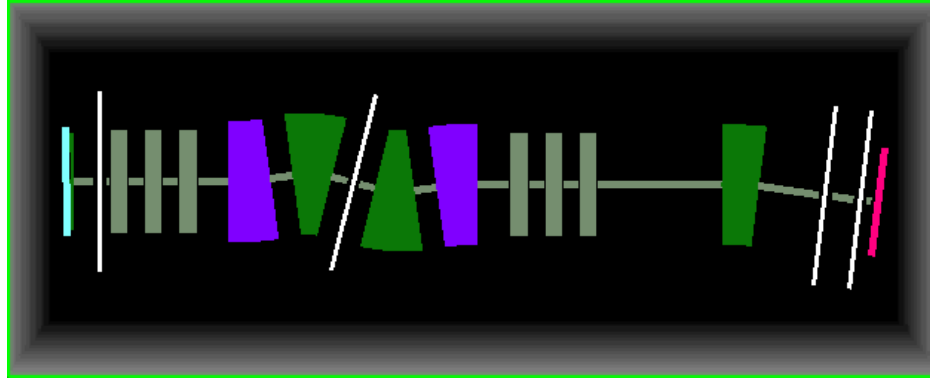


v.9.8.166
from 11/23/14



Separator detail information used to build the LISE++ configuration is courtesy by A.G.Popeko

❖ Introduction

❖ Effective lengths

- ✓ Quadrupoles
- ✓ Dispersive elements

❖ Dispersive elements settings

- ✓ Electrostatic dipoles C1 and C2
- ✓ Magnetic dipoles D22_1 and D22_2
- ✓ Magnetic dipole D8

❖ Apertures & Slits

❖ Calibrations

❖ Reaction choice

- ✓ Charge state model
- ✓ Fusion residual (SHE region)

❖ Configurations

- ✓ Experimental (logbook) settings
- ✓ Brho values by LISE++
- ✓ Q5 field value modification
- ✓ Obtaining angular acceptance
- ✓ Final version for the LISE++ package

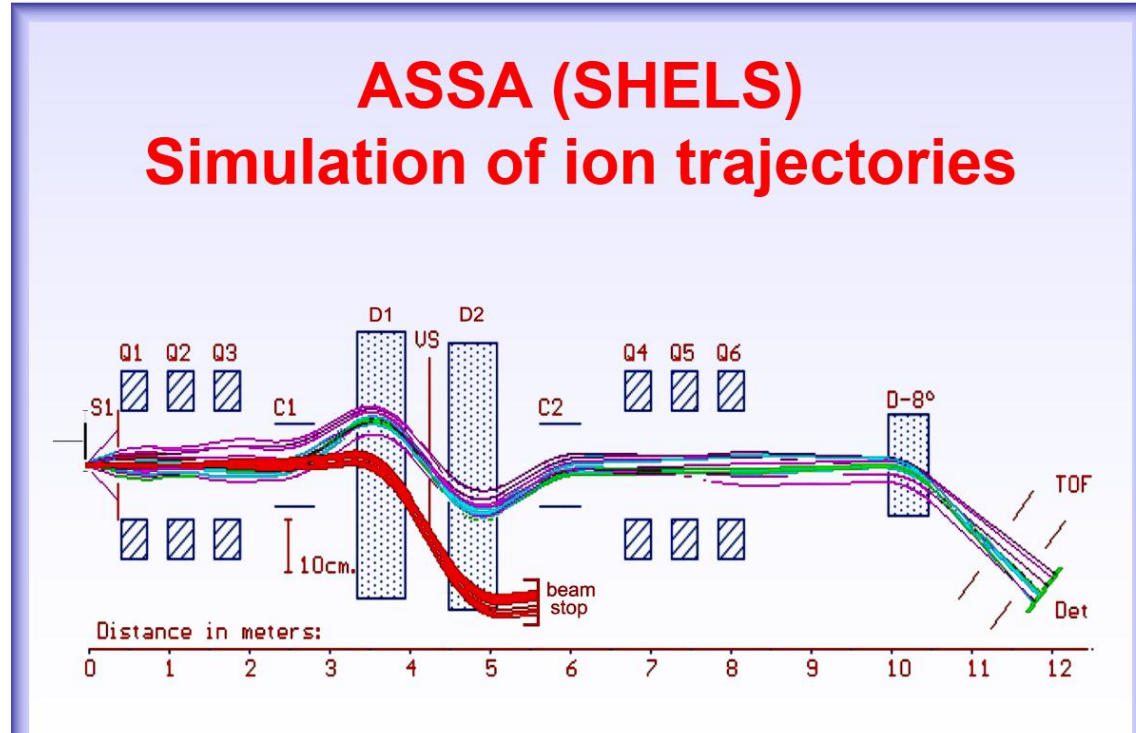
❖ Angular acceptance

❖ Beam suppression

"VASSILISSA" electrostatic separator
 "SHELS" separator

<http://flerovlab.jinr.ru/flnr/vassilissa.html>

http://www-win.gsi.de/tasca14/program/contributions_TASCA14/TASCA14_contribution_Popeko.pdf



The "SHELS" configuration in LISE++ is so called "extended" configuration with effective quadrupole lengths and use of the "S/E" new construction property. For details on these subjects please use the next links:

- Configurations http://lise.nsl.msu.edu/9_8/LISE3/Extended%20configurations%20at%20LISE++.pdf
- Effective quad lengths http://lise.nsl.msu.edu/9_8/QuadEffLengths.pdf
- S/E construction property http://lise.nsl.msu.edu/9_8/SE_blocks.pdf

Original

			"iron"	total	eff.length	delta/2
target			0			
drift	Distance between target and slit 1	DTS1	350	350	350	
slits		Slits1	0	350		
drift	Distance between slit 1 and quadrupole 1	DS1Q1	70	420	35	
Quad1		Quad1	310	730	380	35
drift	Distance between irons of quadrupoles I and I+1	DQiQk	270	1000	200	
Quad2		Quad2	310	1310	380	35
drift	Distance between irons of quadrupoles I and I+1	DQiQk	270	1580	200	
Quad3		Quad3	310	1890	380	35
drift	Distance between quadrupole 3 and C1	DQ3C1	630	2520	516.5	
ElectricDipole	Condensator's 1 plate length	LC1	500	3020	657	78.5
drift	Distance between C1 and dipole 1	DC1D1	561	3581	422.9	
Dipole	Length of dipole 1	LD1	500	4081	619.2	59.6
drift	Distance between D1 and velocity slit SV	DD1SV	365	4446	305.4	
slits1		slits SV	0	4446		
drift	Distance between SV and D2	DSVD2	365	4811	305.4	
Dipole	Length of dipole 2	LD2	500	5311	619.2	59.6
drift	Distance between dipole 2 and C2	DD2C2	561	5872	422.9	
ElectricDipole	Condensator's 2 plate length	LC2	500	6372	657	78.5
drift	Distance between C2 and quadrupole 4	DC2Q4	630	7002	516.5	
Quad4		Quad4	310	7312	380	35
drift	Distance between irons of quadrupoles I and I+1	DQiQk	270	7582	200	
Quad5		Quad5	310	7892	380	35
drift	Distance between irons of quadrupoles I and I+1	DQiQk	270	8162	200	
Quad6		Quad6	310	8472	380	35
drift	Distance between Q6 and S3	DQ6D3	2115	10587	2036	
Dipole		LD3	500	11087	588	44
drift		DQ6D3-DS	1058	12145	1014	
slits 3			0	12145		
drift		DS3Det-D	390	12535	390	
slits 4			0	12535		
drift			110	12645	110	
detectors		TOTAL	12645	12645		

Values used in LISE++ (cells marked white background)

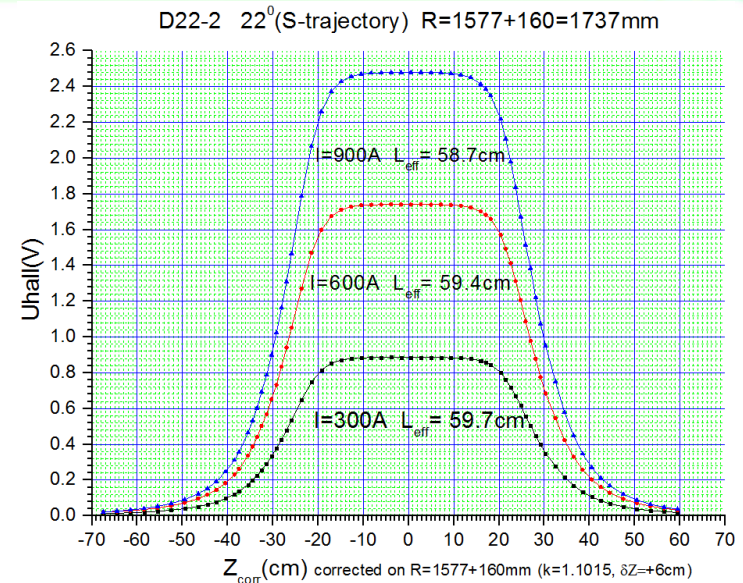
	"iron"	total	eff.length	delta/2	half-app,cm
		0			
DTS1	350	350	350		
Slits1	0	350			
DS1Q1	70	420	35		
Quad1	310	730	380	35	
DQiQk	270	1000	200		
Quad2	310	1310	380	35	
DQiQk	270	1580	200		
Quad3	310	1890	380	35	
DQ3C1	630	2520	516.5		551.5
LC1	500	3020	657	78.5	
DC1D1	561	3581	422.9		
LD1	500	4081	619.2	59.6	
DD1SV	365	4446	305.4		
slits SV	0	4446			
DSVD2	365	4811	305.4		
LD2	500	5311	619.2	59.6	
DD2C2	561	5872	422.9		
LC2	500	6372	657	78.5	
DC2Q4	630	7002	516.5		551.5
Quad4	310	7312	380	35	
DQiQk	270	7582	200		
Quad5	310	7892	380	35	
DQiQk	270	8162	200		
Quad6	310	8472	380	35	
DQ6D3	2115	10587	2036		
LD3	500	11087	588	44	
DQ6D3-DS	1058	12145	1014		
	0	12145			
DS3Det-D	390	12535	390		
	0	12535			
	110	12645	110		
TOTAL	12645	12645	12645		

LISE++ does not support effective dipole lengths, so it has to be set manually

Original information

LD1 = 500; {Length of dipole 1 in mm}
 LD1eff = 650; {Effective length of dipole 1 in mm}
 SDip1 = 0; {Radial shift of dipole 1 axis in mm}

LD2 = 500; {Length of dipole 2 in mm}
 LD2eff = 650; {Effective length of dipole 2 in mm}
 SDip2 = 0; {Radial shift of dipole 2 axis in mm}



Based on the logbook information

LOGBOOK (14.04.2014)		
Br=	0.77	Tm
ID22-8=	508.5	A
B from calibration		
B=	0.47147	T
Radius frm Brho/B		
radius=	1.63319	mm
Alpha=	22.00	deg
Alpha=	0.3840	Rad
Length=	2R*sin(a/2)	
Length=	623.3	mm

Finally used in LISE++ after Br recalculation

Br recal=	0.7622	Tm
ID22-8=	508.5	A
B from calibration		
B=	0.47147	T
radius=	1.616646	
Length=	619.2	mm
Alpha=	0.385396	Rad
Alpha=	22.082	Deg
Arc=	0.623049	m

Eff.Length= $2R \cdot \sin(a/2)$

D22_1

Dispersive block

Brho 0.76221 + Tm

B 0.47147 + T

I 508.5 + A

Bend Sector

Radius = 1.61665 m

Angle = 22.08 deg

Length = 0.6230 m

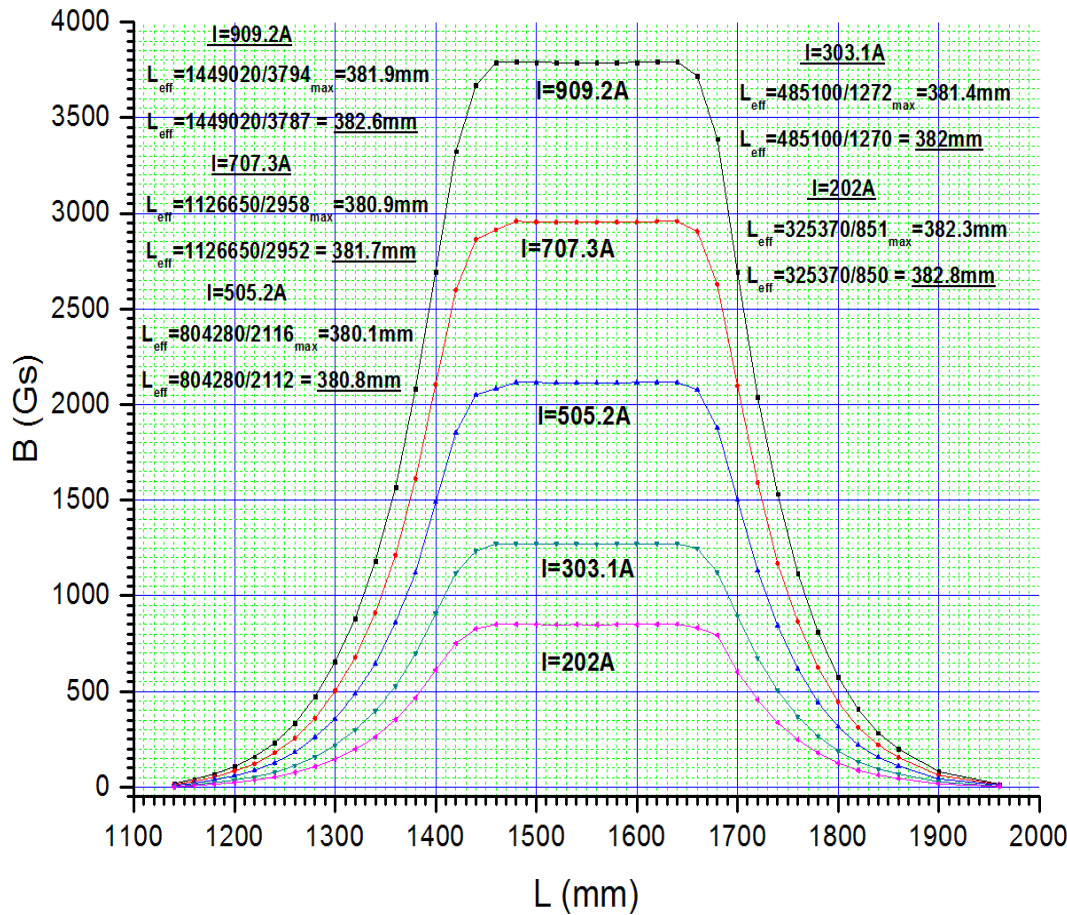
Used in simulations:

LQ = 310; {Length of quadrupole iron in mm}

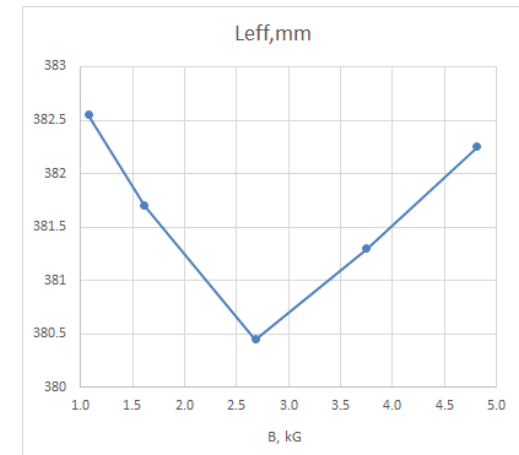
LQeff = 380; {Effective length of quadrupole in mm}

6 identical quads

Q1 (pole 4) effective length on R rel.=0

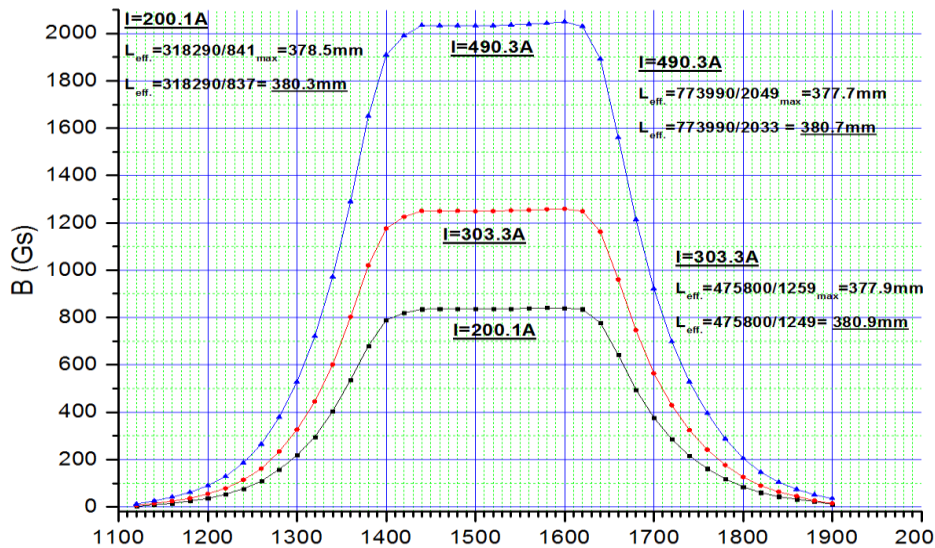


I	B, kG	Leff,mm
202	1.08	382.55
303	1.615	381.7
505	2.68368	380.45
707	3.7504	381.3
909	4.8124	382.25
average		381.65

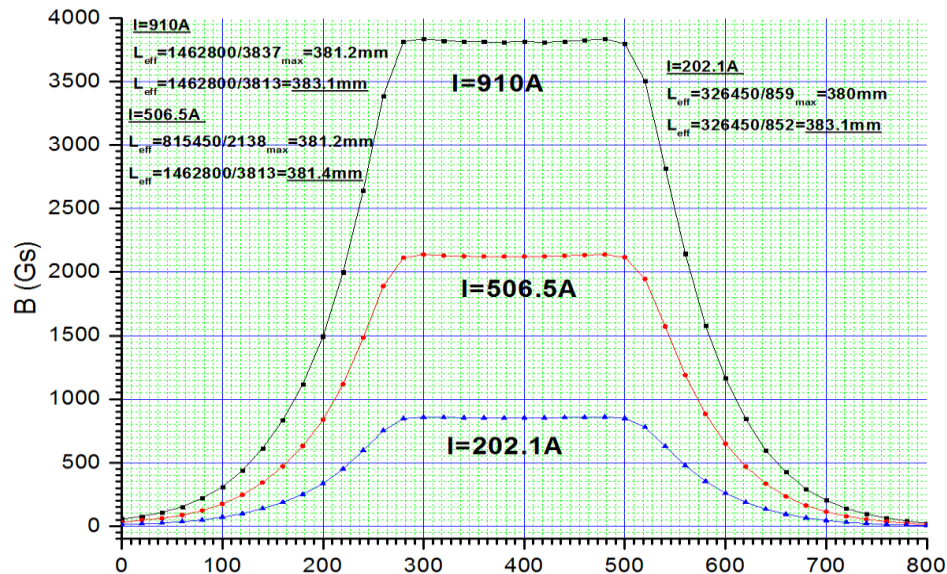


Effective Lengths measurement

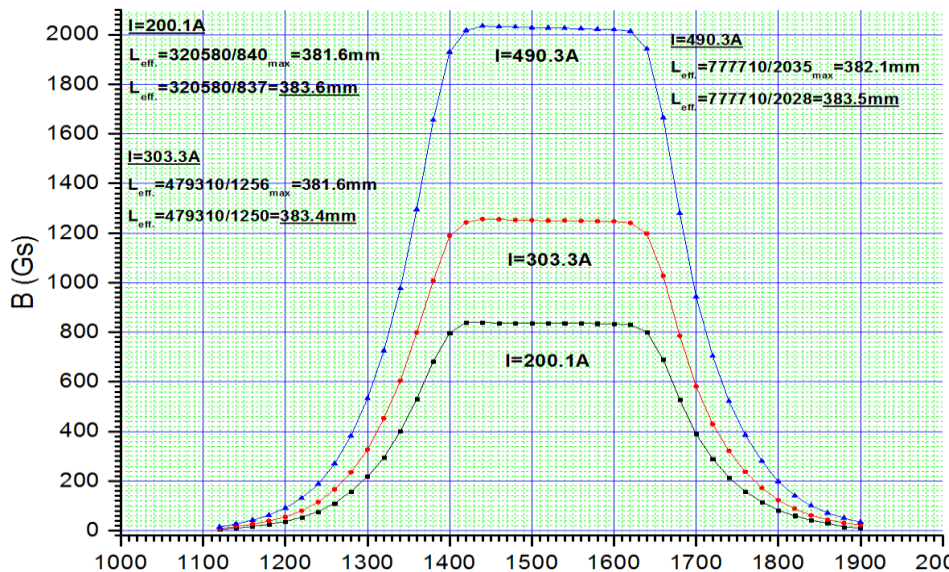
Q6 (pole4) eff. length



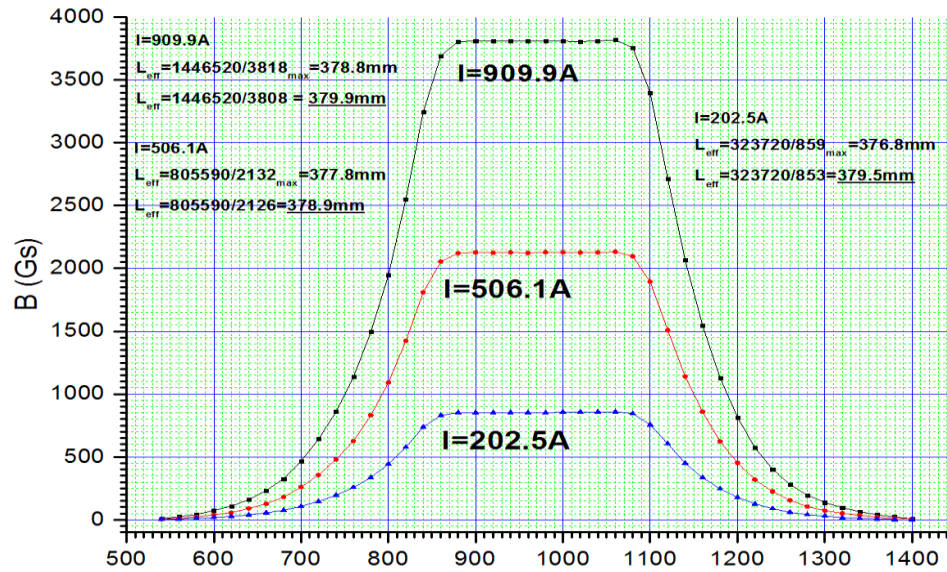
Q3 (pole 3) effective length



Q6(pole3) eff. length



Q2 (pole3) effective length



	Quad 1-6
a (Half-aperture) [cm]	10
iron length [mm]	310
effective in the code [mm]	380
Leff = L + coef * a	
coef (calculation)=	0.700

For information :

The same coefficient value 0.7 has been obtained in the case of NSCL A1900 quads
http://lise.nslc.msu.edu/9_8/QuadEffLengths.pdf#page=5

Multipole: Quad 1

Magnetic Multipole Settings

QUADrupole SEXTupole

L_eff (effective length)
 mode: <Calc> [c=0.70] 0.38 m

B (field at pole tip) 5.02249 0 kG

Radius (half-aperture) 10 10 cm

Multipole fixed Brho-value corresponding to the setting fragment 0.74886 Tm

Calculate 2nd order matrix elements

Allow remote matrices recalculation

Quad 1 : multipole effective length

Note:
 Effective length is used for optical matrix calculation.
 Block length is used for time-of-flight calculations

Equal to Block Length (L)
 Set manually by user
 Calculated : Leff = L + a*coef

where
 "L": block (physical) length [m]
 "a": half-aperture [m] **coef = 0.7**
recommended value is 0.7

Neighbour blocks have to be drifts. Their effective lengths will be recalculated in order to compensate this effective quad length.

Obtained from calibration file Leff= f(B)

For all six SHELS quads

Use double "logbook" voltage value !!

AC1 = 200; {Distance between plates of condenser 1 in mm}

RadiusLC1 = $L_{eff} / \sin(\alpha)$

Alpha=	8.000	deg
Eff.Length=	657	mm
RadiusLC1 =	4.721	m

```

Utility: Electrostatic deflector
Electrostatic dipole
mode = Cylindrical
direct = X
radius = 4.72 m
angle = -8 deg
length = 0.6592 m
n = 0
beta = 0.019192
e_xi = 1.4141
n_eta = 0
nk = 0.99991
ka = 9.2082e-05
k2x = 0.0897 m^(-2)
k2y = 0 m^(-2)

-----
transport format [cm-arad]
* TRANSFORM 1 *
[D] -- Momentum transfer matrix (Important!)
1 [X]: +9.8057e-01 +6.5490e-02 0 0 0 -9.1723e-02
2 [Y]: -5.8757e-01 +9.8057e-01 0 0 0 -2.7739e+00
3 [Z]: 0 0 1 +6.5918e-02 0 0
4 [F]: 0 0 0 1 0 0
5 [L]: +2.7739e-01 +9.1723e-03 0 0 0 -8.5475e-03
6 [D]: 0 0 0 0 0 1

-----
transport format [cm-arad]
* TRANSFORM 1 *
[D] -- Electrostatic rigidity selection (Important!)
1 [X]: +9.8057e-01 +6.5490e-02 0 0 0 -4.5670e-02
2 [Y]: -5.8757e-01 +9.8057e-01 0 0 0 -1.3872e+00
3 [Z]: 0 0 1 +6.5918e-02 0 0 0
4 [F]: 0 0 0 1 0 0
5 [L]: +1.3872e-01 +4.5670e-03 0 0 0 -2.1377e-03
6 [D]: 0 0 0 0 0 1
    
```


Br recal=	0.7622	Tm
ID22-8=	508.5	A
B from calibration		
B=	0.47147	T
radius=	1.616646	
Length=	619.2	mm
Alpha=	0.385396	Rad
Alpha=	22.082	Deg
Arc =	0.623049	m

D22_1

Dispersive block

- Brho: 0.74886 Tm
- B: 0.46322 T
- I: 499.367 A

Bend Sector

- Radius = 1.61665 m
- Angle = 22.08 deg
- Length = 0.6230 m

Allow remote matrices calculation

Matrix calculations

Optical block properties and data

Section-Element construction property

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

Setting Charge state for the Block (Z-Q): 84

Calculate the Values using the Setting fragment from

Cut(Slits) & Acceptances: C1

Optical matrix: D22_2

General setting of block:

Calibration file:

Tweak: 0.1 %

Calculate other optic blocks:

OK Cancel Help

D22_1

Bending magnet settings: (Important!! -> USE IT only in extended configurations)

Use Entrance and Exit faces of bending magnet in calculations

Type Code	Description	Value	Dimension
16.5	g/2 - Vertical half-aperture of bending magnet	6.7	cm
16.7	K1 - an integral related to the extent of the fringing field of a bending magnet	0.7	
16.8	K2 - a second integral related to the extent of the fringing field of a bending magnet	4.4	
16.12	1/R1 - where R1 is the radius of curvature of the entrance face	0	1/m
2.0	Beta1 - Angle of pole-face rotation (pay attention for angle sign!)	11	degrees
4.0 0.623 4.632...	$n = - \left[\frac{1}{h B_y} \left(\frac{\partial B_y}{\partial x} \right) \right]_{x=0, y=0} = 0$	0	
MAGNET	* this line has been set in the parent dialog (Radius, Bfield, angle)	$\beta = \left[\frac{1}{2h^2 B_y} \left(\frac{\partial^2 B_y}{\partial x^2} \right) \right]_{x=0, y=0} = 0$	0
16.13	1/R2 - where R2 is the radius of curvature of the exit face	0	1/m
2.0	Beta2 - Angle of pole-face rotation (pay attention for angle sign!)	11	degrees

Calculate 2nd order matrix elements

Calculate Optical matrix Copy These Calculations in the Block Matrix

Cancel

YDlim = 67;
{Halfheight of dipoles gap in mm}

Dipole Transport Calculations : D22_1

transport format [ca-nrad]

```

* TRANSFORM 1 *
1 [X]: +9.9973e-01 +6.0770e-02 0 0 0 +1.1857e-01
2 [Y]: -8.9631e-03 +9.9973e-01 0 0 0 +3.9016e+00
3 [Z]: 0 0 +9.4814e-01 +6.2301e-02 0 0
4 [F]: 0 0 -1.6216e+00 +9.4814e-01 0 0
5 [L]: -3.9016e-01 -1.1857e-02 0 0 1 -1.5306e-02
6 [D]: 0 0 0 0 0 1

* TRANSFORM 2 *
1 1: -1.8197e-05
1 2: +3.7572e-04 +5.9250e-06
1 3: 0 0 +3.5566e-06
1 4: 0 0 -2.0923e-04 -1.8386e-05
1 5: 0 0 0 0 0
1 6: +7.4876e-04 +4.5411e-05 0 0 -1.1405e-03
2 1: +2.4039e-04
2 2: +2.2583e-04 -1.9503e-04
2 3: 0 0 -1.6398e-04
2 4: 0 0 +1.5369e-04 -1.8106e-04
2 5: 0 0 0 0 0
2 6: +1.0235e-03 -7.3149e-04 0 0 0 -4.0495e-02
3 1: 0
3 2: 0
3 3: -3.0763e-04 -4.2400e-04 0
3 4: +3.6210e-04 +1.0972e-05 0
3 5: 0 0 0 0 0
3 6: 0 0 0 +7.3634e-04 +1.5306e-05 0
4 1: 0
4 2: 0
4 3: -7.6980e-03 +3.3937e-04 0
4 4: -8.1410e-04 +4.0415e-04 0
4 5: 0 0 0 0 0
4 6: 0 0 +2.3434e-02 +7.3634e-04 0 0
5 1: +4.3927e-05
5 2: -2.7711e-06 0
5 3: 0 0 -1.2539e-03
5 4: 0 0 +2.7711e-06 0
5 5: 0 0 0 0 0
5 6: +1.4256e-04 0 0 0 0 0
    
```

For example, a symmetrically oriented rectangular bending magnet whose total bend is 10 degrees would be represented by the three entries 2. 5. ; 4. --- ; 2. 5. ;

D3Alfa = 0.1274; {Bending angle 7.3 of central trajectory in dipole D3 in rad}
 LD3 = 500; {Length of dipole in mm}
 LD3eff = 588; {Effective length of dipole in mm}
 D3W05 = 95; {Half width of dipole 3 in mm}
 SD3 = 0; {Radial shift of dipole axis in mm (245)}
 betaD3 = 0.070; {Rear pole face-rotation angle of dipole D3 (0.07)}
 YD3lim = 70; {Halfheight of dipole camera in mm 70}

RadiusLD8 = Leff / sin(alpha)	
Alpha= 7.300	deg
Eff.Length= 588	mm
RadiusD8= 4.628	m
Alpha= 0.1274	rad
RadiusD8= 4627.6	mm
Arc= 0.5896	

D8
 Dispersive block:
 Brho 0.74886 Tm
 B 0.16181 T
 I 397.241 A
 Bend Sector:
 Radius = 4.628 m
 Angle = 7.3 deg
 Length = 0.5896 m
 Allow remote matrices calculation
 Matrix calculations
 Optical block properties and data:
 Section-Element: S-block (Section) | **E-block (Element)**
 Setting Charge state for the Block (Z-Q): 84
 Calculate the Values using the Setting fragment from: E C2
 Cut (Slits) & Acceptances
 Optical matrix
 General setting of block
 Calibration file
 Tweak: 0.1 %
 Calculate other optic blocks
 OK Cancel Help

D8
 Bending magnet settings: (Important!! -> USE IT only in extended configurations)
 Use Entrance and Exit faces of bending magnet in calculations

Type Code	Description	Value	Dimension
16.5	g/2 - Vertical half-aperture of bending magnet	7	cm
16.7	K1 - an intergal related to the extent of the fringing filed of a bending magnet	0.7	
16.8	K2 - a second intergal related to the extent of the fringing filed of a bending magnet	4.4	
16.12	1/R1 - where R1 is the radius of curvature of the entrance face	0	1/m
2.0	Beta1 - Angle of pole-face rotation (pay attention for angle sign!)	0	degrees
4.0	0.588 1.623...		
$n = - \left[\frac{1}{h} \frac{\partial B_y}{\partial x} \right]_{z=0, y=0} = 0$			
$\beta = \left[\frac{1}{2h^2} B_y \left(\frac{\partial^2 B_y}{\partial x^2} \right) \right]_{z=0, y=0} = 0$			
16.13	1/R2 - where R2 is the radius of curvature of the exit face	0	1/m
2.0	Beta2 - Angle of pole-face rotation (pay attention for angle sign!)	4	degrees

Calculate 2nd order matrix elements
 Calculate Optical matrix
 Copy These Calculations in the Block Matrix
 Cancel

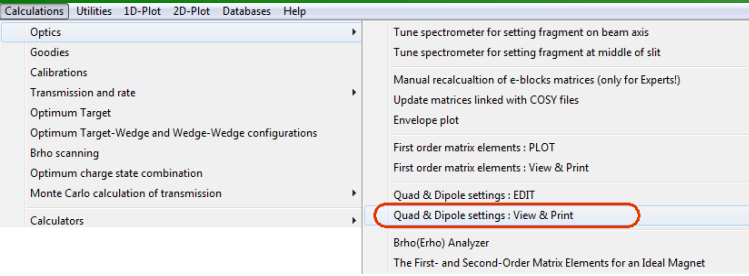
Dipole Transport Calculations : D8

transport format [cm-mrad]

```

* TRANSFORM 1 *
1 [X]: +9.9189e-01 +5.8806e-02 0 0 0 +3.7513e-02
2 [Y]: -1.2469e-01 +1.0008e+00 0 0 0 +1.2763e+00
3 [Z]: 0 +1.0027e+00 +5.8965e-02 0 0 0
4 [F]: 0 0 -5.9664e-02 +9.9380e-01 0 0
5 [L]: -1.2706e-01 -3.7513e-03 0 0 1 -1.5940e-03
6 [D]: 0 0 0 0 0 1

* TRANSFORM 2 *
1 1: -1.2246e-05
1 2: +1.2634e-04 +1.8787e-06
1 3: 0 0 -1.4044e-05
1 4: 0 0 -6.4102e-05 -5.6503e-06
1 5: 0 0 0 0 0
1 6: +1.6165e-04 +4.7782e-06 0 0 0 -3.7360e-04
2 1: -5.4355e-07
2 2: +8.6017e-06 -6.3870e-05
2 3: 0 0 -1.3564e-04
2 4: 0 0 +7.5982e-06 -6.3195e-05
2 5: 0 0 0 0 0
2 6: +1.2579e-03 -8.8923e-05 0 0 0 -1.2820e-02
3 1: 0 0
3 2: 0 0 -4.6652e-06 -1.2786e-04
3 3: +1.2645e-04 +3.7146e-06
3 4: 0 0 0 0
3 5: 0 0 0 0
3 6: 0 0 +7.2945e-08 +1.5940e-06 0 0
4 1: 0 0
4 2: 0 0
4 3: -2.7134e-04 +2.5637e-05
4 4: -1.8844e-05 +1.2836e-04
4 5: 0 0 0 0
4 6: 0 0 +1.5109e-03 +8.8925e-05 0 0
5 1: 0 0
5 2: 0 0
5 3: 0 0 -1.3728e-04
5 4: 0 0 0 0
5 5: 0 0 0 0
5 6: 0 0 0 0 0 0
  
```



Note: Slits 4 are temporary not used due to large transmission cut of fragment of interest. It should be discussed!

Quads & Dipoles settings

FILE: C:_Popeko\SHELS.lpp

N or	2	3	4	5	6	7	8	9	10	11	12	13	slits				aperture					
													14	15	16	17	18	19	20	21	22	23
	Block name	Kind of Block	Start (m)	Length (m)	DriftMode Angle(")*	B0(kG)	Br-corrsp Br-dip*	Rapp(cm) R(m)*	L_eff(m) Len(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
1.	tuning	Dipole	0.000	0.000	+0.0 *	+2.496	0.7489*	3.00*	0.00*	-								ellps				
2.	DTS1	Drift	0.000	0.350	standard													ellps	-90	+90	-90	+90
3.	slits 1	Drift	0.350	0.000	SLITS													ellps	-90	+90	-90	+90
4.	DS1Q1	Drift	0.350	0.070	standard													ellps	-90	+90	-90	+90
5.	Quad 1	Drift	0.420	0.310	multipole	+5.022	0.7489	10.00	0.38	yes	1							ellps	-90	+90	-90	+90
6.	dqiqk	Drift	0.730	0.270	standard													ellps	-90	+90	-90	+90
7.	Quad 2	Drift	1.000	0.310	multipole	-4.581	0.7489	10.00	0.38	yes	1							ellps	-90	+90	-90	+90
8.	dqiqk	Drift	1.310	0.270	standard													ellps	-90	+90	-90	+90
9.	Quad 3	Drift	1.580	0.310	multipole	+2.239	0.7489	10.00	0.38	yes	1							ellps	-90	+90	-90	+90
10.	dq3c1	Drift	1.890	0.551	standard													ellps	-90	+90	-90	+90
11.	C1	ElecDip	2.442	0.659	-8.0 *	179.2kV	0.7489*	4.72*	0.66*	-								rectn	-100	+100	-175	+175
12.	dc1d1	Drift	3.101	0.423	standard													rectn	-100	+100	-175	+175
13.	D22_1	Dipole	3.524	0.623	+22.1 *	+2.496	0.7489*	1.62*	0.62*	yes								rectn	-215	+215	-67	+67
14.	dd1sv	Drift	4.147	0.305	standard													ellps	-215	+215	-67	+67
15.	slits SV	Drift	4.452	0.000	SLITS													rectn	-100	+100	-67	+67
16.	dsvd2	Drift	4.452	0.305	standard													rectn	-215	+215	-67	+67
17.	D22_2	Dipole	4.757	0.623	-22.1 *	+2.496	0.7489*	1.62*	0.62*	yes								rectn	-215	+215	-67	+67
18.	dd2c2	Drift	5.380	0.423	standard													rectn	-216	+216	-67	+67
19.	C2	ElecDip	5.803	0.659	+8.0 *	179.2kV	0.7489*	4.72*	0.66*	-								rectn	-100	+100	-175	+175
20.	dc2q4	Drift	6.463	0.551	standard													ellps	-90	+90	-90	+90
21.	Quad 4	Drift	7.014	0.310	multipole	+0.699	0.7489	10.00	0.38	yes	1							ellps	-90	+90	-90	+90
22.	dqiqk	Drift	7.324	0.270	standard													ellps	-90	+90	-90	+90
23.	Quad 5	Drift	7.594	0.310	multipole	-3.300	0.7489	10.00	0.38	yes	1							ellps	-90	+90	-90	+90
24.	dqiqk	Drift	7.904	0.270	standard													ellps	-90	+90	-90	+90
25.	Quad 6	Drift	8.174	0.310	multipole	+2.358	0.7489	10.00	0.38	yes	1							ellps	-90	+90	-90	+90
26.	dq6d3	Drift	8.484	2.115	standard													ellps	-90	+90	-90	+90
27.	D8	Dipole	10.599	0.590	+7.3 *	+2.496	0.7489*	4.63*	0.59*	yes								rectn	-95	+95	-70	+70
28.	drift	Drift	11.189	1.058	standard													ellps	-95	+95	-70	+70
29.	slits 3	Drift	12.247	0.000	SLITS													rectn	-40	+40	-40	+40
30.	drift	Drift	12.247	0.390	standard													rectn				
31.	slits 4	Drift	12.637	0.000	SLITS													ellps	-40	+40	-40	+40
32.	drift	Drift	12.637	0.110	standard													rectn				

! symbol "*" after values denotes, that these values belongs to Dipole settings, where column names are found in the second row of titles, and also marked by "*"

! Column 08: "Br-corrsp" - quadrupole(sextupole) field is scaled to this Brho-value; "Br-dip*" - dipole magnetic rigidity [T*m]

! Column 09: "Rapp(cm)" - radius(half-aperture) of quadrupole(sextupole) in cm; "R(m)-dip*" - dipole radius [m]

! Column 10: "L_eff(m)" - effective length of quadrupole(sextupole) in m, which is used for Optical matrix calculations; "Len(m)*" - dipole length at their central axis [m]

! Column 12: "Calc mode" - only for quadrupole(sextupole); 0 - no actions; 1 - recalculate automatically B(field), keep matrix;

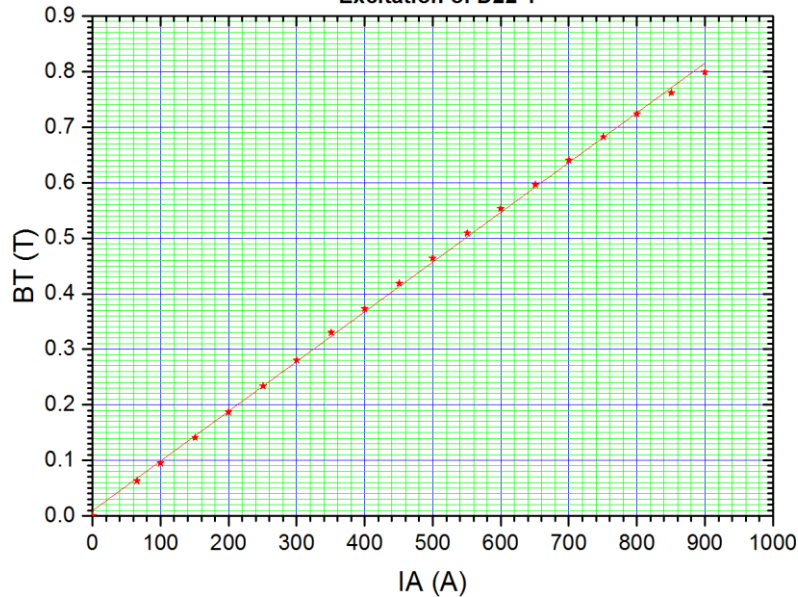
! 2 - recalculate automatically the matrix, keep B(field)

! Column 13: "AngAcc mode" - "H(V)": horizontal(vertical) angular acceptance will be applied for this block

! Columns 15-18,20-23: slits and aperture(limit) sizes in [mm]. If slit or aperture(limit) does not have action, then its size value is absent

OT, 11/23/14, East Lansing

Excitation of D22-1



Calibration data of all 6 quad, m-dipoles D22-1, D22-2 and D8 have been transported to LISE++ calibrated files and linked to the SHELS configuration to be used in the corresponding dialogs.

Calibration files are located in the directory "calibrations\FLNR".

Q6	cal	151	11/21/2014
Q5	cal	232	11/21/2014
Q4	cal	166	11/21/2014
Q3	cal	314	11/21/2014
Q2	cal	329	11/21/2014
Q1	cal	315	11/21/2014
D8	cal	576	11/03/2014
D22_1	cal	277	11/03/2014
D22_2	cal	257	11/03/2014

Multipole: Quad 1

Magnetic Multipole Settings

	QUADrupole	SEXTUpole	
L _{eff} (effective length) mode: <Calc> [c=0.70]	0.38		m
B (field at pole tip)	5.02249	0	kG
Radius (half-aperture)	10	10	cm
Multipole fixed Brho-value corresponding to the setting fragment	0.74886		Tm
		Fix current value	
<input checked="" type="checkbox"/> Calculate 2nd order matrix elements	B(I) calibration		
<input checked="" type="checkbox"/> Allow remote matrices recalculation	+853.29 A		

Quad 1: quadrupole filed calibration

B	5.0225	kG
C	853.288	A

Calibration file

Accept value & Exit Quit

Calibration file

Open file View file Clear

Q1.cal

Columns = 2 OK Cancel

Rows = 21

Note

The calibration file is in ASCII format. The first line contains 2 integer values describing the structure of the file:

1. Number of columns (either 2 or 3)
2. Number of rows (calibrated points)

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

1st column: the Current (I) required

2nd : Magnetic field (B read) from NMR required

3rd : set Magnetic filed (B set) optional

```
c:\program files (x86)\lise\calibrations\FLNR\Q1.cal
2 21
0 01212
50.4 0 30859
100.8 0 6054
151.3 0 90265
201.9 1 19972
252.4 1 49687
302.9 1 79407
353.5 2 09152
404 2 38848
454.5 2 68556
505.1 2 98245
555.7 3 27909
606.1 3 57586
656.7 3 87217
707.2 4 16828
757.7 4 46376
808.3 4 75929
858.7 5 05419
909.1 5 34773
959.5 5 64015
999.6 5 87045
```

$^{208}\text{Pb}(^{50}\text{Ti}, 2n)^{256}\text{Rf}$ experiment used to create configuration (logbook 14.04.2014)

Energy = 237 MeV
 Target ^{208}PbS (0.35mg Pb)

Beam configuration window showing parameters for the experiment. The 'Element' field is set to Ti (Z=22, A=50). The 'Beam energy' is set to 237 MeV. The 'Emittance' parameters are: 1. X mm = 1, 2. T mrad = 10, 3. Y mm = 1, 4. P mrad = 10, 5. L mm = 0, 6. D % = 0.1.

Production Mechanism window showing the reaction configuration. The reaction is $^{50}\text{Ti}(4.7\text{ MeV/u}) + \text{PbS} \rightarrow ^{256}\text{Rf}$. The 'Reactions' list includes 'Fusion -> Residual' which is selected. The 'Settings' button for 'Fusion -> Residual' is highlighted with a blue box.

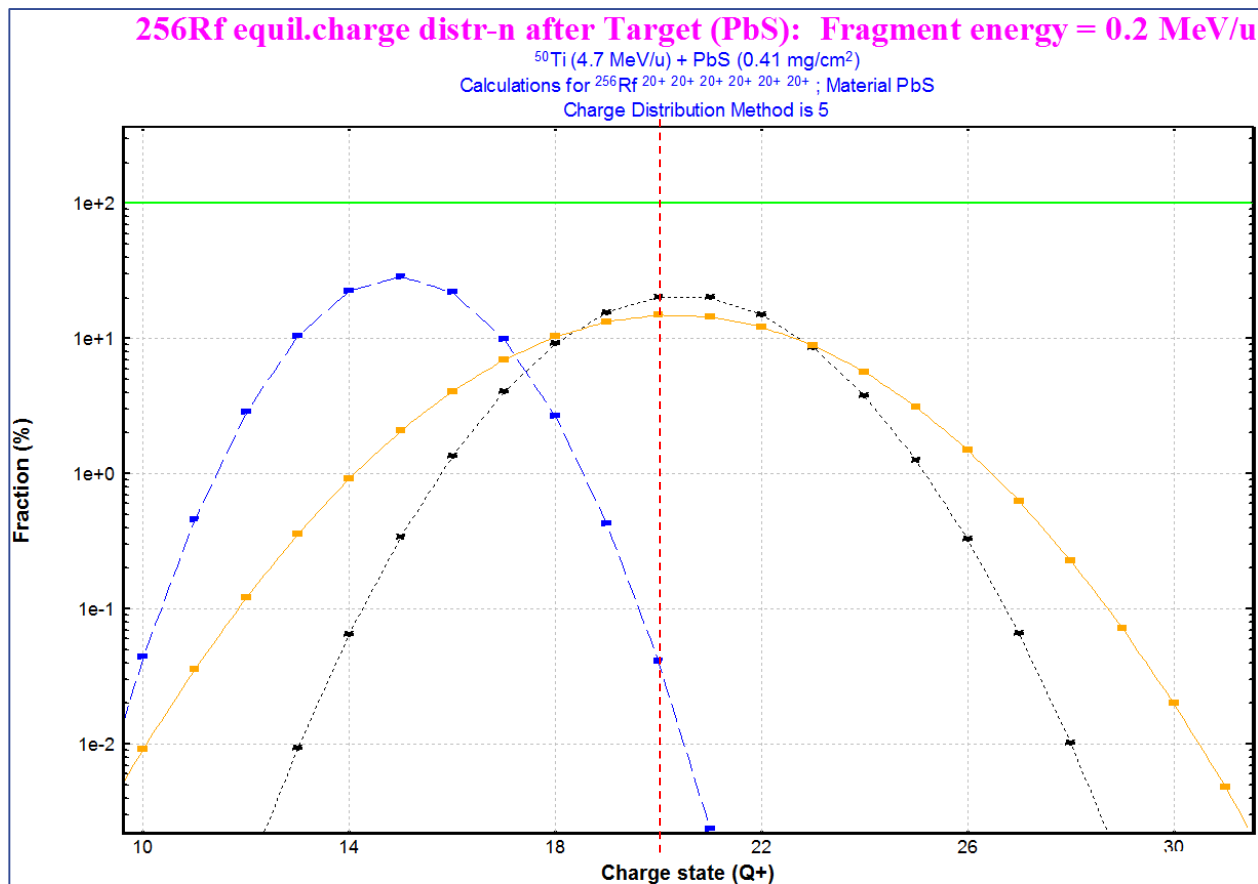
Target configuration window showing parameters for the target. The target is PbS with a density of 6.706 g/cm³. The 'Dimension' is set to 0.406 mg/cm². The 'State' is Solid. The 'Thickness at 0 degrees' is 0.60542797 micron. The 'Effective Thickness' is 0.406 mg/cm². The 'Use in Q-state calculations' checkbox is checked.

5 - [< 15A MeV] G.Schiwietz, P.Grande, NIM B175-177 (2001) 125-131

Schiwietz's model has been chosen for this reaction
with setting charge state 20+

According to the logbook
<q> = 19.5, sig(q) = 2.44

Question: The Sulfur component has
been taken into account ?



N	distribution	x-mean	x-max	y-max	deviation	FWHM
01	0-Winger	+4.4900e+01	+4.5000e+01	1.689e+01	2.372e+00	5.576e+00
02	1-Leon	+1.4979e+01	+1.5000e+01	2.882e+01	1.401e+00	3.292e+00
03	2-Shima	+2.0463e+01	+2.0000e+01	2.031e+01	1.923e+00	4.601e+00
04	3-GLOBAL+W	+4.4900e+01	+4.5000e+01	1.689e+01	2.372e+00	5.576e+00
05	4-GLOBAL+L	+1.4979e+01	+1.5000e+01	2.882e+01	1.401e+00	3.292e+00
06	5-Schiwietz	+2.0292e+01	+2.0000e+01	1.491e+01	2.672e+00	6.307e+00

Reaction choice: Fusion residual (SHE region)

Fusion -> Residual

Evaporation settings

Transmission probability for a one-dimensional potential barrier

Classical

Quantum-mechanical

\hbar_{ω} - Curvature parameter of the parabolic potential describing the barrier (default value 3 MeV) MeV

Probability for compound nucleus formation P_{CN}

Take into account the Probability for compound nucleus formation P_{CN} according to V.Zagrebaev & W.Greiner, PRC78, 034610 (2008)

Partner site

OK Make default

Fusion Evaporation

Cancel Help

Temporarily turned off

For nuclei in this region, which are absent in data file

Fission Barrier

A Element Z

SF and Alpha decay

Sierk barrier information

Barrier vanishes at = \hbar

Fission Barrier Plot

For models # 0,1,2

Barfac = factor to multiply the fission barrier (default value 1)

Use LISE shell corrections for LDM

Use odd-even corrections for LDM

Odd-Even Delta parameters

for Protons: default 9.0 MeV

for Neutrons: default 2.5 MeV

For models # 3,4

if FILE data are absent then use LDM model #

Use in the code	Fission Barrier at L=0	Fission Barrier at Lx = 10	G.S. Energy at Lx (MeV)
<input type="radio"/> 0 - "Barit" - A.J.Sierk, PRC33(1986)2039	5.27	0	0
<input type="radio"/> 1 - "FisRot" - S.Cohen et al.An.P 82(1974)	6.77	6.56	0.31
<input type="radio"/> 2 - LDM - W.Myers,W.Swiatecki,NP81(1966)	7.07		
<input type="radio"/> 3 - FILE: A.Mamdouh et al.NPA679(2001)337	5.2		
<input type="radio"/> 4 - FILE: Experimental barriers			
<input checked="" type="radio"/> 5 - FILE: P.Moller et al.LANL-UR-08-4190	5.65		

in out max (in,out)

Ok Cancel Help Make default

Fusion information window

50Ti(4.7 MeV/u) + PbS -> 258Rf* -> 256Rf

Q-value of reaction = -169.521 MeV

Fusion max.barrier = 194.28 MeV

Fusion radius = 12.40 fm

Depending on a place of reaction in the target

	beginning	middle	end
Beam energy (Lab) [MeV/u]	4.75	4.71	4.67
Beam energy (Lab) [MeV]	237.0	235.0	233.0
Center of mass energy [MeV]	190.95	189.33	187.71
Excitation energy [MeV]	21.43	19.81	18.19
Compound recoil energy [MeV]	46.0	45.6	45.2

Fusion cross section [mb] 0.728 0.137 0.0254

Fusion- 1st Fission CS [mb] 0.627 0.12 0.0226

Fusion-Breakup CS [mb] 0 0 0

for setting residue after the stripper

Energy diapason (MeV/u) 0.158 .. 0.175

Corresponding ion charge state 19.90 .. 20.82

Plot the excitation function

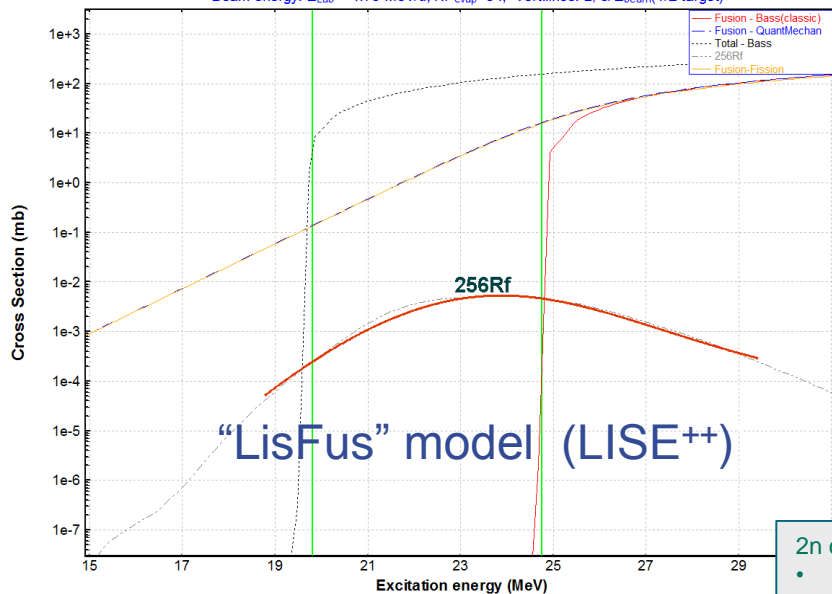
All fusion characteristics are calculated with BASS-model

Fusion-Residue calculator

Quit

Cross sections (Fusion-Residual)

$^{50}\text{Ti} + ^{208}\text{Pb} \rightarrow ^{258}\text{Rf}^*$ ($Q = -169.52$) Model: LisFus v.4.0 Fis.Bar: MeV=5.65 P.Möller...LANL-UR-08
 $V_{\text{Coulomb}} = 191.19$ MeV; Fusion height $^{E_{\text{BASS}}}_{\text{max}}$: Br = 194.28 MeV; $h_{\text{omega}} = 6.00$ MeV
 Beam energy: $E_{\text{Lab}} = 4.75$ MeV/u; $NP_{\text{evap}}=64$; Vert.Lines: Br & $E_{\text{beam}}(1/2 \text{ target})$



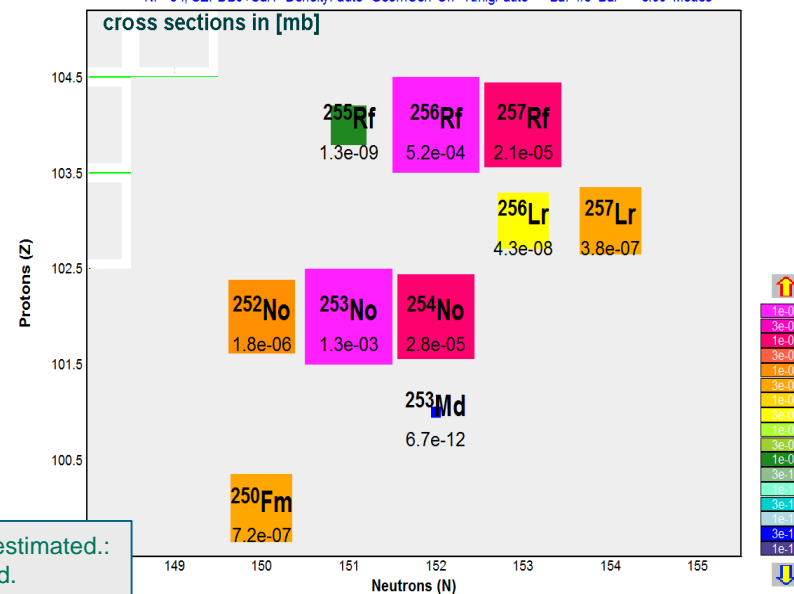
“LisFus” model (LISE++)

2n channel is overestimated.:

- No $P_{\{CN\}}$ used.
- Play with Kramers coefs for fission.
- Fission barriers

Final Evaporation Residue cross-sections (LisFus)

EVAPORATION - Compound nucleus ^{258}Rf
 Excit.Energy: 18.2-21.4 MeV; Fus.CS: 0.3 mb; Fus.Barrier: 194.28 fm; $h_{\text{omega}} = 6.0$ MeV
 $NP=64$, SE:“DB0+Cal1” Density:“auto” GeomCor:“On” Tunlg:“auto” $F_{\text{is}}^{\text{Bar}}\#5$ $\text{Bar}^{\text{Fis}}=6.00$ Modes= $^{1010}1000110$



The influence of projectile neutron number in the $^{208}\text{Pb}(^{48}\text{Ti}, n)^{255}\text{Rf}$ and $^{208}\text{Pb}(^{50}\text{Ti}, n)^{257}\text{Rf}$ reactions

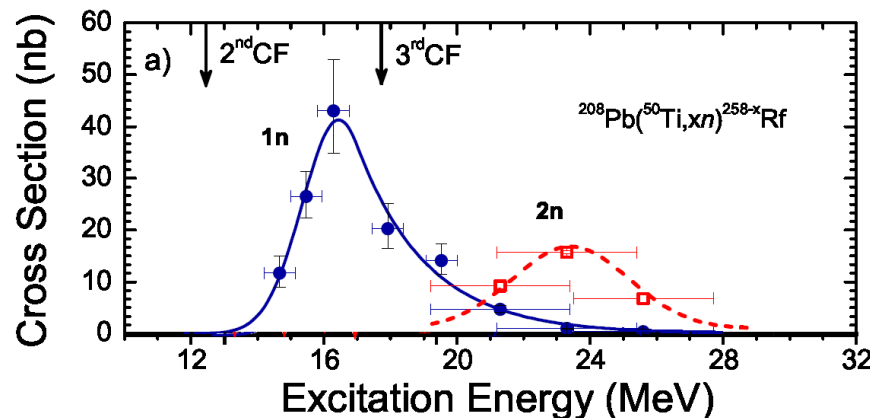
I. Dragojević^{1,2}, K.E. Gregorich², Ch. E. Düllmann^{1,2,3}, M.A. Garcia^{1,2}, J.M. Gates^{1,2},

S.L. Nelson^{1,2}, L. Stavsetra², R. Sudowe^{2,*}, and H. Nitsche^{1,2}

¹ Department of Chemistry, University of California, Berkeley, California 94720, U.S.A.










² Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720, U.S.A.

³ Abteilung Kernchemie, Gesellschaft für Schwerionenforschung mbH, 64291 Darmstadt, Germany



http://lise.nsci.msu.edu/9_8/SHELS/

Index of /9_8/SHELS

Name	Last modified	Size	Description
 Parent Directory		-	
 SHELS.lcn	23-Nov-2014 17:08	153K	
 SHELS.lpp	23-Nov-2014 17:08	182K	
 SHELS.xlsx	23-Nov-2014 19:15	49K	
 SHELSinLISE.pdf	23-Nov-2014 19:14	3.6M	
 SHELS v9.lpp	21-Nov-2014 18:18	173K	
 SHELS v9 brho.lpp	21-Nov-2014 18:21	173K	
 SHELS v9 brho quad5.lpp	23-Nov-2014 17:08	182K	
 SHELS v9 brho quad5 acceptance.lpp	21-Nov-2014 18:17	173K	

The LISE⁺⁺ package already contains the SHELS configuration and calibration files.
Please use v.9.8.166

- ✓ Experimental (logbook) settings [SHELS v9.lpp](#)
- ✓ Brho values by LISE⁺⁺ [SHELS v9 brho.lpp](#)
- ✓ Q5 field value modification [SHELS v9 brho quad5.lpp](#)
- ✓ Obtaining angular acceptance [SHELS v9 brho quad5 acceptance.lpp](#)
- ✓ Final version for the LISE⁺⁺ package [SHELS.lpp](#) [SHELS.lcn](#)

Multipole: Quad 1

Magnetic Multipole Settings

QUADrupole	SEXTupole	
L_eff (effective length) mode: <Calc> [c=0.70]	0.38	m
B (field at pole tip)	5.11196	0 kG
Radius (half-aperture)	10	10 cm
Multipole fixed Brho-value corresponding to the setting fragment	0.7622	Tm
	Fix current value	
<input checked="" type="checkbox"/> Calculate 2nd order matrix elements	B(I) calibration	
<input checked="" type="checkbox"/> Allow remote matrices recalculation	+868.60 A	

Multipole: Quad 2

Magnetic Multipole Settings

QUADrupole	SEXTupole	
L_eff (effective length) mode: <Calc> [c=0.70]	0.38	m
B (field at pole tip)	-4.66283	0 kG
Radius (half-aperture)	10	10 cm
Multipole fixed Brho-value corresponding to the setting fragment	0.7622	Tm
	Fix current value	
<input checked="" type="checkbox"/> Calculate 2nd order matrix elements	B(I) calibration	
<input checked="" type="checkbox"/> Allow remote matrices recalculation	-798.10 A	

Multipole: Quad 3

Magnetic Multipole Settings

QUADrupole	SEXTupole	
L_eff (effective length) mode: <Calc> [c=0.70]	0.38	m
B (field at pole tip)	2.27922	0 kG
Radius (half-aperture)	10	10 cm
Multipole fixed Brho-value corresponding to the setting fragment	0.7622	Tm
	Fix current value	
<input checked="" type="checkbox"/> Calculate 2nd order matrix elements	B(I) calibration	
<input checked="" type="checkbox"/> Allow remote matrices recalculation	+387.40 A	

14.04.2014

Техническое задание $^{50}\text{Ti}(237\text{MeV}) + 208\text{Pb}(0.55\text{мкс Pb}) \rightarrow Rf + 24$

$\langle E \rangle = 42.5$ $\langle q \rangle = 19.5$ $z_p = 2.44$ $E_c = 45.9$ $E_c^* = 21.5$

$UC^* = 304.6 \cdot \frac{1}{2} \cdot \frac{E}{\rho} = 304.6 \cdot 2.179 \cdot 10^8$
 $= 463.72 \cdot 0.1405 = 99.2 \text{ kV}$

$I_{Q1} = 868.6 \text{ A}$
 $I_{Q2} = 798.1 \text{ A}$
 $I_{Q3} = 387.4 \text{ A}$

$I_{P22-8^\circ} = 2.223 \cdot \sqrt{\frac{A}{E}} \cdot U = 508.5 \text{ A}$

$B_p = 0.144 \sqrt{A \cdot E / w} = 0.770 \text{ T} \cdot \text{m} \rightarrow B = 0.167 \text{ T}$

$I_{P8} = 429.5 \text{ A}$

Should be double value

C1

Electrostatic Dipole Settings

Separation plane
 Horizontal Vertical

E (electric field) 932 KV/m

U (voltage) 186.4 KV

Electric rigidity 4.4 MJ/C

Magnetic rigidity 0.76369 Tm

(corresponds to the setting fragment)

U_C1 = U_C2

Multipole: Quad 4

Magnetic Multipole Settings

QUADrupole	SEXTupole	
L_eff (effective length) mode: <Calc> [c=0.70]	0.38	m
B (field at pole tip)	0.713	0 kG
Radius (half-aperture)	10	10 cm

Multipole fixed Brho-value corresponding to the setting fragment: 0.76369 Tm
Fix current value

Calculate 2nd order matrix elements
 Allow remote matrices recalculation

B(I) calibration: +120.54 A

Multipole: Quad 5

Magnetic Multipole Settings

QUADrupole	SEXTupole	
L_eff (effective length) mode: <Calc> [c=0.70]	0.38	m
B (field at pole tip)	-2.33153	0 kG
Radius (half-aperture)	10	10 cm

Multipole fixed Brho-value corresponding to the setting fragment: 0.76369 Tm
Fix current value

Calculate 2nd order matrix elements
 Allow remote matrices recalculation

B(I) calibration: -398.60 A

Multipole: Quad 6

Magnetic Multipole Settings

QUADrupole	SEXTupole	
L_eff (effective length) mode: <Calc> [c=0.70]	0.38	m
B (field at pole tip)	2.40032	0 kG
Radius (half-aperture)	10	10 cm

Multipole fixed Brho-value corresponding to the setting fragment: 0.76369 Tm
Fix current value

Calculate 2nd order matrix elements
 Allow remote matrices recalculation

B(I) calibration: +302.70 A

14.04.2014

Точность 3-45 $^{50}\text{Ti}(237\text{MeV}) + 208\text{Pb}(0.55\text{mg Pb}) \rightarrow Rf + 24$

$\langle E \rangle = 42.5$ $\langle q \rangle = 19.5$ $z_q = 2.44$ $E_c = 45.9$ $E_c^* = 21.5$

$I_{Q1} = 868.6 \text{ A}$
 $I_{Q2} = 798.1 \text{ A}$
 $I_{Q3} = 387.4 \text{ A}$
 $I_{Q4} = 120.3 \text{ A}$
 $I_{Q5} = 394.6 \text{ A}$
 $I_{Q6} = 302.7 \text{ A}$

$408^\circ = 304.6 \cdot \tan \alpha = \frac{E}{\rho} = 304.6 \cdot 2.179 \cdot 10^8 \text{ m}^{-1}$
 $= 463.72 \cdot 0.1405 = 99.2 \text{ kV}$

$I_{D22-8^\circ} = 2.223 \cdot \sqrt{\frac{A}{E}} \cdot U = 508.5 \text{ A}$

$B_D = 0.144 \sqrt{A \cdot E} / w = 0.770 \text{ T} \cdot \text{m} \rightarrow B = 0.167 \text{ T}$

$I_{D8} = 429.5 \text{ A}$

D8

Dispersive block (M-dipole)

Brho 0.78454 Tm
 B 0.17 T
 I 429.5 A

Bend Sector
 Radius = 4.615 m
 Angle = 7.3 deg
 Length = 0.5880 m

D22_1

Dispersive block (M-dipole)

Brho 0.76221 Tm
 B 0.47147 T
 I 508.508 A

Bend Sector
 Radius = 1.61665 m
 Angle = 22.08 deg
 Length = 0.6230 m

$Br_{D22_1} = Br_{D22_2}$

Calculations Utilities 1D-Plot 2D-Plot Databases Help

- Optics
- 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

Tune spectrometer for setting fragment on beam axis
Tune spectrometer for setting fragment at middle of slit

Manual recalculation of e-blocks matrices (only for Experts!)

Update matrices linked with COSY files

Envelope plot

First order matrix elements : PLOT
First order matrix elements : View & Print

Quad & Dipole settings : EDIT

Quad & Dipole settings : View & Print

Brho(Erho) Analyzer
The First- and Second-Order Matrix Elements for an Ideal Magnet

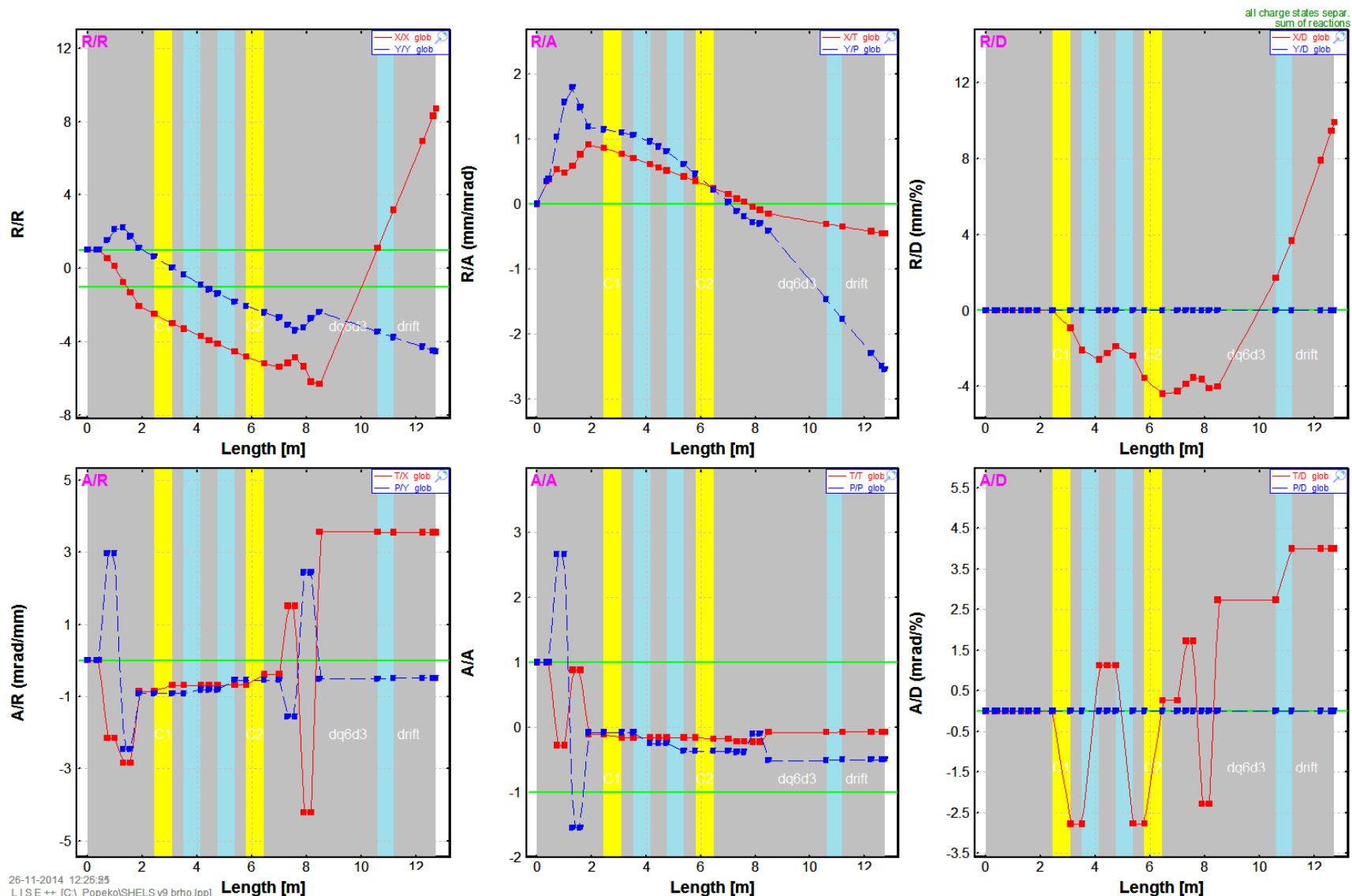
The sectors with different rigidities

Quadrupoles and dipoles fast editing

Block	Given Name	Start(m)	Length(m)	B0(kG)	Br(Tm)cor/*real	DriftM/*Angle	Rapp(cm)*R(...)	Leff(m)*Ldip(m)	2nd order	CalcMatr/*Z-Q	AngAcc.Apps.Slits	COSY_link	SE	
S	Drift	dqiqk	0.730	0.2700		standard		c_0.2000			-- HV --	-	e	
Q	Drift	Quad 2	1.000	0.3100	-4.6628	0.7637	QUAD	10.0000	c_0.3800	yes	-- HV --	-	e	
S	Drift	dqiqk	1.310	0.2700		standard		c_0.2000			-- HV --	-	e	
Q	Drift	Quad 3	1.580	0.3100	+2.2792	0.7637	QUAD	10.0000	c_0.3800	yes	-- HV --	-	e	
S	Drift	dq3c1	1.890	0.5515		standard		c_0.5165			-- HV --	-	e	
E	ElecDip	C1	2.442	0.6592	186.4kV	0.7637	* -8.0	* 4.7210	* 0.6592	-	* 84	-- HV --	-	E
S	Drift	dc1d1	3.101	0.4229		standard					-- HV --	-	e	
D	Dipole	D22_1	3.524	0.6230	+4.7147	* 0.7622	* +22.1	* 1.6166	* 0.6230	yes	* 84	-- HV --	-	E
S	Drift	dd1sv	4.147	0.3054		standard					-- HV --	-	e	
S	Drift	slits SV	4.452	0.0000		SLITS					-- HV --	-	e	
S	Drift	dsvd2	4.452	0.3054		standard					-- HV --	-	e	
D	Dipole	D22_2	4.757	0.6230	-4.7147	* 0.7622	* -22.1	* 1.6166	* 0.6230	yes	* 84	-- HV --	-	E
S	Drift	dd2c2	5.380	0.4229		standard					-- HV --	-	e	
E	ElecDip	C2	5.803	0.6592	186.4kV	0.7637	* +8.0	* 4.7210	* 0.6592	-	* 84	-- HV --	-	E
S	Drift	dc2q4	6.463	0.5515		standard		c_0.5165			-- HV --	-	e	
Q	Drift	Quad 4	7.014	0.3100	+0.7130	0.7637	QUAD	10.0000	c_0.3800	yes	-- HV --	-	e	
S	Drift	dqiqk	7.324	0.2700		standard		c_0.2000			-- HV --	-	e	
Q	Drift	Quad 5	7.594	0.3100	-2.3315	0.7637	QUAD	10.0000	c_0.3800	yes	-- HV --	-	e	
S	Drift	dqiqk	7.904	0.2700		standard		c_0.2000			-- HV --	-	e	
Q	Drift	Quad 6	8.174	0.3100	+2.4003	0.7637	QUAD	10.0000	c_0.3800	yes	-- HV --	-	e	
S	Drift	dq6d3	8.484	2.1150		standard		c_2.0800			-- HV --	-	e	
D	Dipole	D8	10.599	0.5880	+1.7000	* 0.7845	* +7.3	* 4.6150	* 0.5880	yes	* 84	-- HV --	-	E
S	Drift	drift	11.187	1.0580		standard					-- HV --	-	e	

First order matrix elements

^{50}Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on $^{256}\text{Rf}^{20+..20+}$; Config: DSSSSSSSSSESDSSSDSESSSSSSSS...
 dp/p=10.14% ; Brho(Tm): 0.7637, 0.7622, 0.7622, 0.7845



26-11-2014 12:25:25
 TISE++ [C:\Popeko\SHEL5 v9 brho.ipp]

Overall transmission
45.1%

statistics: 256Rf

Analytical solution

256Rf Spontaneous fission (Z=104, N=152) Rutherfordium

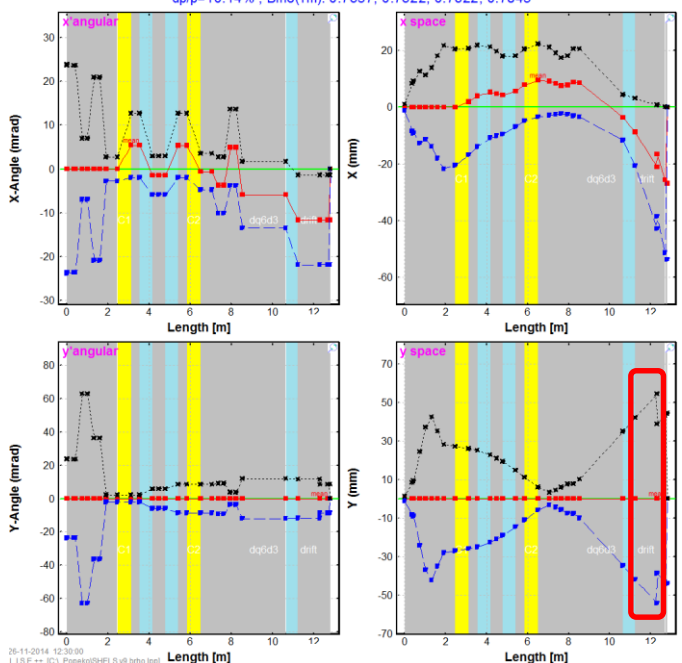
All reactions total isotope rate 1.55e+0 pps
and Overall isotope transmission 45.789 %

Reaction	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	
Q1 (tuning)	27	26	25	24	23	22	21	20	19	18	17	16	15	14	
Q2 (C1)	27	26	25	24	23	22	21	20	19	18	17	16	15	14	
Q3 (D22_1)	27	26	25	24	23	22	21	20	19	18	17	16	15	14	
Q4 (D22_2)	27	26	25	24	23	22	21	20	19	18	17	16	15	14	
Q5 (C2)	27	26	25	24	23	22	21	20	19	18	17	16	15	14	
Q6 (D8)	27	26	25	24	23	22	21	20	19	18	17	16	15	14	
Ion Production Rate (pps)	5.9e-4	3.23e-3	1.31e-2	3.92e-2	8.92e-2	1.6e-1	2.29e-1	4.59e-1	7.89e-1	1.59e-1	2.09e-1	1.43e-1	8.31e-2	4.15e-2	1.78e-2
Total ion transmission (%)	0.017	0.095	0.385	1.154	2.629	4.7	6.743	7.89	1.621	6.155	4.204	2.449	1.222	0.525	
Total: this reaction (pps)	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	1.55e+0	
X-Section in target (mb)	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	
Target (%)	0.629	1.51	3.14	5.68	8.94	12.22	14.49	14.9	13.31	10.32	6.95	4.07	2.08	0.922	
X space transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Y space transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Unreacted in material (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
Q (Charge) ratio (%)	0.629	1.51	3.14	5.68	8.94	12.22	14.49	14.9	13.31	10.32	6.95	4.07	2.08	0.922	
Unstopped in material (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	

Analytical solution

Envelope for 256Rf FusRes 20+ 20+ 20+ 20+ 20+ 20+

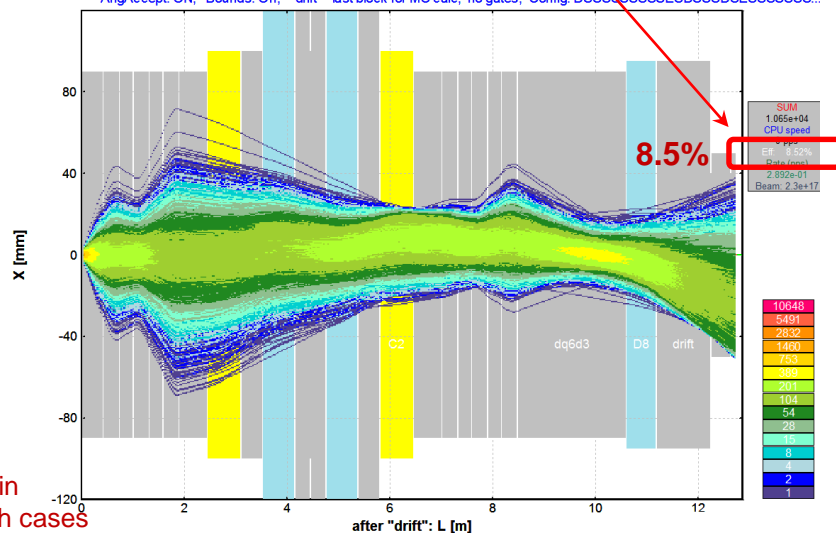
⁵⁰Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on 256Rf20+ 20+
dp/p=10.14%; Brho(Tm): 0.7637, 0.7622, 0.7622, 0.7845



MC solution

²⁵⁶Rf: MC Transmission Plot - Envelope (only passed)

⁵⁰Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Transmitted Fragment ²⁵⁶Rf20+ 20+ (FusRes); Optics Order: 1
dp/p=10.14%; Brho(Tm): 0.7637, 0.7622, 0.7622, 0.7845
AngAccept: ON; Bounds: Off; "drift" - last block for MC calc; no gates; Config: DSSSSSSSSSESSDSSSESSSSSSSS...



About 50% lost in the slits 3 in both cases
slits 4 were not used

Angular Acceptance & Bounds

- Use fixed angular acceptances
- Take into account thickness defect of materials
- Use physical limits (aperture) inside blocks to calculate fragment transmission
- Take into account losses due to reactions in materials
- Include charge state calculations in the total transmission **

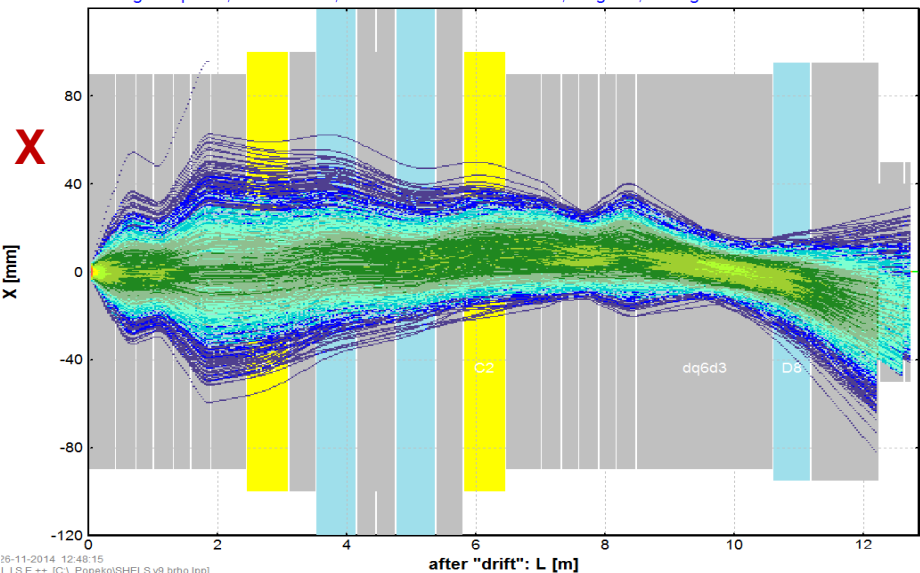
For block apertures LISE++ uses the slit limits accessible from the Block Cut & Acceptance dialog. IPav attention there for the checkbox

** time consumed options

²⁵⁶Rf : MC Transmission Plot - Envelope (all)

⁵⁰Ti (4.7 MeV/u) + PbS (0.41 mg/cm²) ; Transmitted Fragment ²⁵⁶Rf^{20+ 20+} (FusRes) ; Optics Order: dp/p=10.14% ; Brho(TM): 0.7637, 0.7622, 0.7622, 0.7845

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

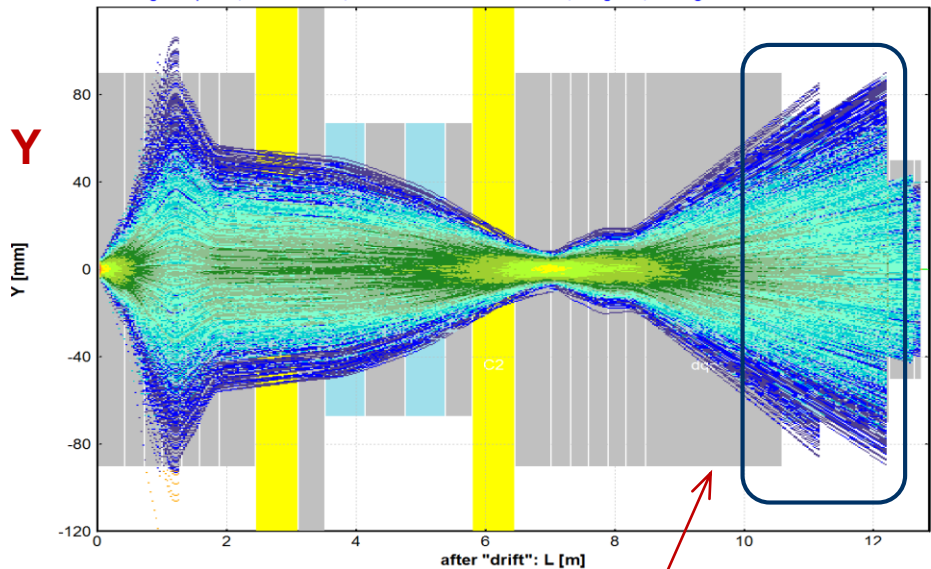


15-11-2014 12:48:15
LISE++ IC1 PopokoSHELS v9 brho.txt

²⁵⁶Rf : MC Transmission Plot - Envelope (all)

⁵⁰Ti (4.7 MeV/u) + PbS (0.41 mg/cm²) ; Transmitted Fragment ²⁵⁶Rf^{20+ 20+} (FusRes) ; Optics Order: dp/p=10.14% ; Brho(TM): 0.7637, 0.7622, 0.7622, 0.7845

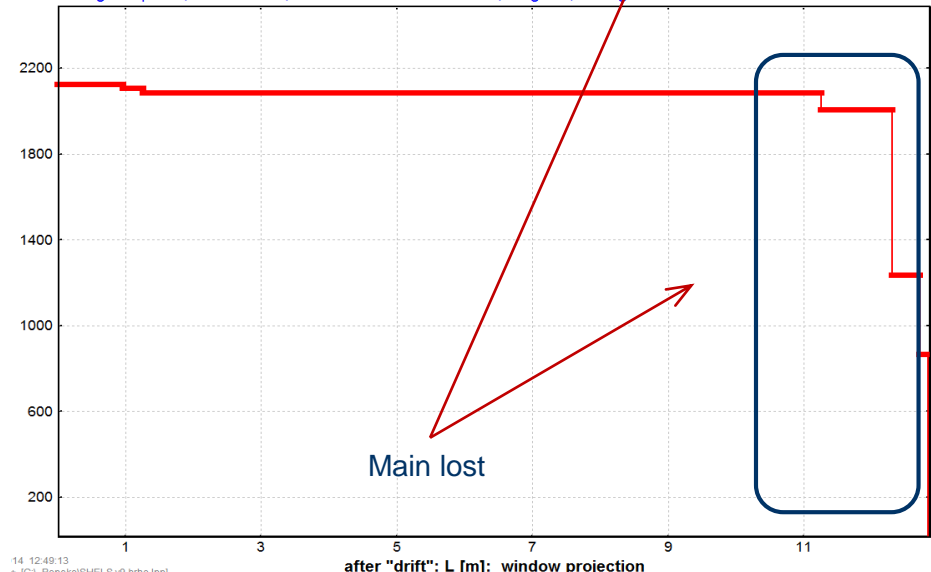
AngAccept: Off, Bounds: ON; "drift" - last block for MC calc; no gates; Config: DSSSSSSSESSESSSSDSESSSSSSSS



²⁵⁶Rf : MC Transmission Plot - Envelope (all)

after "drift": L [m]: window projection --- ⁵⁰Ti (4.7 MeV/u) + PbS (0.41 mg/cm²) ; Transmitted Fragment ²⁵⁶Rf^{20+ 20+} (FusRes) ; Optics Order: dp/p=10.14% ; Brho(TM): 0.7637, 0.7622, 0.7622, 0.7845

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



14 12:48:13
IC1 PopokoSHELS v9 brho.txt

MC solution

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)

- Take into account thickness defect of materials

- Take into account losses due to reactions in materials in the total transmission ***
 - Include charge state calculations
- *** time consumed options

Assume the reaction takes place at the middle of target

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

All disperse optical blocks were set to Brho = 0.7489 Tm
calculated by LISE⁺⁺ to be optimal for ²⁵⁶Rf²⁰⁺

[SHELs v9 brho.lpp](#)

Block	Given Name	Start(m)	Length(m)	B0(kG)	Br(Tm)cor/*real	DriftM/*Angle	Rapp(cm)*R(...	Leff(m)*Ldip(m)	2 nd order	CalcMatr/*Z-Q	AngAcc.Apps.Slits	COSY_link	SE
Q	Drift Quad 1	0.420	0.3100	+5.0127	0.7489	QUAD	10.0000	c_0.3800	yes	1	-- HV --	-	e
S	Drift dq1qk	0.730	0.2700			standard		c_0.2000			-- HV --	-	e
Q	Drift Quad 2	1.000	0.3100	-4.5723	0.7489	QUAD	10.0000	c_0.3800	yes	1	-- HV --	-	e
S	Drift dq1qk	1.310	0.2700			standard		c_0.2000			-- HV --	-	e
Q	Drift Quad 3	1.580	0.3100	+2.2350	0.7489	QUAD	10.0000	c_0.3800	yes	1	-- HV --	-	e
S	Drift dq3c1	1.890	0.5515			standard		c_0.5165			-- HV --	-	e
E	ElecDip C1	2.442	0.6592	179.2kV	0.7489	* -8.0	* 4.7210	* 0.6592	-	* 84	-- HV --	-	E
S	Drift dc1d1	3.101	0.4229			standard					-- HV --	-	e
D	Dipole D22_1	3.524	0.6230	+4.6322	* 0.7489	* +22.1	* 1.6166	* 0.6230	yes	* 84	-- HV --	-	E
S	Drift dd1sv	4.147	0.3054			standard					-- HV --	-	e
S	Drift slits SV	4.452	0.0000			SLITS					-- HV --	-	e
S	Drift dsvd2	4.452	0.3054			standard					-- HV --	-	e
D	Dipole D22_2	4.757	0.6230	-4.6322	* 0.7489	* -22.1	* 1.6166	* 0.6230	yes	* 84	-- HV --	-	E
S	Drift dd2c2	5.380	0.4229			standard					-- HV --	-	e
E	ElecDip C2	5.803	0.6592	179.2kV	0.7489	* +8.0	* 4.7210	* 0.6592	-	* 84	-- HV --	-	E
S	Drift dc2q4	6.463	0.5515			standard		c_0.5165			-- HV --	-	e
Q	Drift Quad 4	7.014	0.3100	+0.6992	0.7489	QUAD	10.0000	c_0.3800	yes	1	-- HV --	-	e
S	Drift dq1qk	7.324	0.2700			standard		c_0.2000			-- HV --	-	e
Q	Drift Quad 5	7.594	0.3100	-2.2863	0.7489	QUAD	10.0000	c_0.3800	yes	1	-- HV --	-	e
S	Drift dq1qk	7.904	0.2700			standard		c_0.2000			-- HV --	-	e
Q	Drift Quad 6	8.174	0.3100	+2.3537	0.7489	QUAD	10.0000	c_0.3800	yes	1	-- HV --	-	e
S	Drift dq6d3	8.484	2.1150			standard		c_2.0800			-- HV --	-	e
D	Dipole D8	10.599	0.5880	+1.6227	* 0.7489	* +7.3	* 4.6150	* 0.5880	yes	* 84	-- HV --	-	E

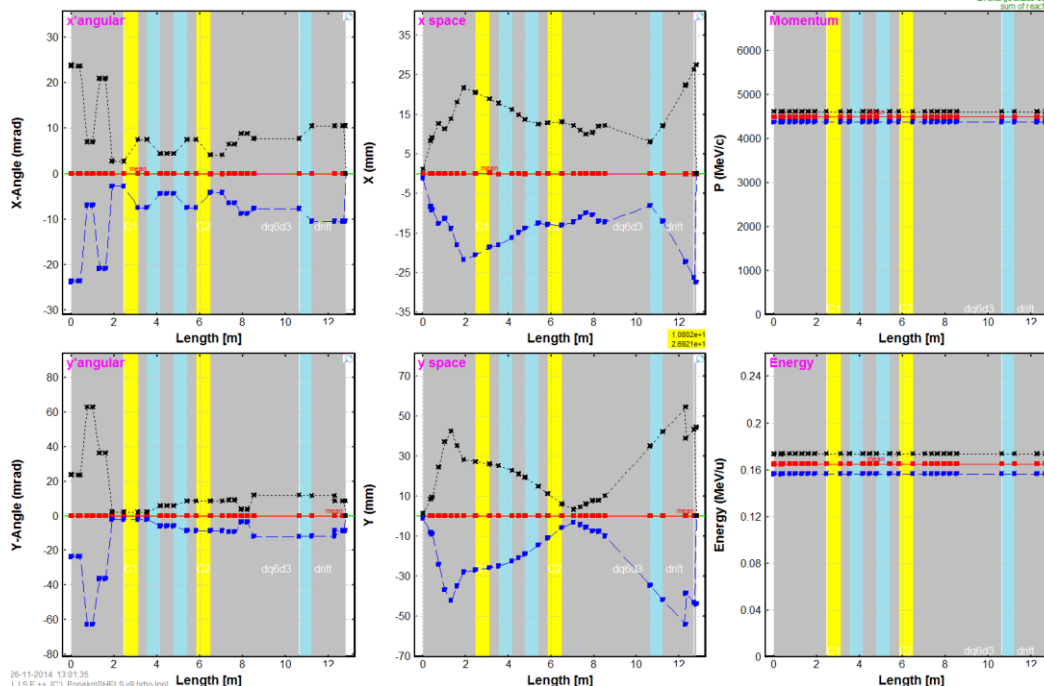
Overall transmission
54.3%

statistics: 256Rf														
256Rf Spontaneous fission (Z=104, N=152) Rutherfordium														
SHELS v9 brho.lpp														
All reactions total isotope rate 1.84e+0 pps														
and Overall isotope transmission 54.294 %														
Q1 (tuning)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q2 (C1)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q3 (D22_1)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q4 (D22_2)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q5 (C2)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q6 (D8)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Reaction	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes
Ion Production Rate (pps)	4.18e-3	1.47e-2	4.06e-2	8.94e-2	1.61e-1	2.38e-1	2.94e-1	3.06e-1	2.7e-1	2e-1	1.24e-1	6.41e-2	2.8e-2	1.05e-2
Total ion transmission (%)	0.123	0.434	1.195	2.634	4.728	7.006	8.661	9.02	7.94	5.883	3.646	1.89	0.825	0.308
Total: this reaction (pps)	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0	1.84e+0
X-Section in target (mb)	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4
Target (%)	0.631	1.51	3.14	5.69	8.95	12.23	14.49	14.9	13.3	10.31	6.94	4.06	2.07	0.919
X space transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Y space transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Unreacted in material (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Q (Charge) ratio (%)	0.631	1.51	3.14	5.69	8.95	12.23	14.49	14.9	13.3	10.31	6.94	4.06	2.07	0.919
Unstopped in material (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
tuning (%)	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96
X angular transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Y angular transmission (%)	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96
DTS1 (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Analytical solution

Envelope for ²⁵⁶Rf FusRes 20+ 20+ 20+ 20+ 20+ 20+

⁵⁰Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on ²⁵⁶Rf^{20+, 20+}; Config: DSSSSSSSESDDSSDDSSSSSSSSSS...
dp/p=10.14%; Brho(TM): 0.7489, 0.7489, 0.7489, 0.7489



Still large lost in the slits3

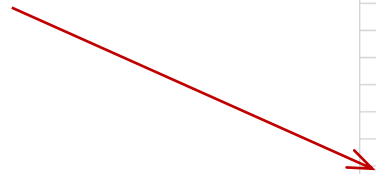
Transmission through the slits 3 about 62% for the setting ion (vertical cut)

slits 4 were not used

It's necessary to make vertical focusing at the end. See matrix elements on page 21

Let's use Q5 B-field equal to -4kG (-685A)

Q5, B(kG)	Overall Transmission
-2.2863	54.30%
-3	68.40%
-3.1	70.20%
-3.2	72.01%
-3.3	73.83%
-3.4	75.39%
-3.5	76.92%
-3.6	78.09%
-3.7	79.22%
-3.8	80.03%
-3.9	80.57%
-4	80.70%
-4.1	80.82%
-4.2	80.61%



Analytical solution

Overall transmission 80.7%

statistics: 256Rf														
256Rf Spontaneous fission (Z=104, N=152) Rutherfordium														
All reactions total isotope rate 80.697 %														
and Overall isotope transmission 80.697 %														
Q1 (tuning)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q2 (C1)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q3 (D22_1)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q4 (D22_2)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q5 (C2)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Q6 (D8)	27	26	25	24	23	22	21	20	19	18	17	16	15	14
Reaction	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes
Ion Production Rate (pps)	6.3e-3	2.45e-2	7.14e-2	1.57e-1	2.67e-1	3.73e-1	4.44e-1	4.56e-1	4.07e-1	3.11e-1	1.78e-1	4.28e-2	1.54e-3	1.41e-6
Total ion transmission (%)	0.185	0.722	2.104	4.613	7.87	10.99	13.067	13.441	11.992	9.173	5.233	1.262	0.045	4.16e-5
Total: this reaction (pps)	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0	2.74e+0
X-Section in target (mb)	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4	2.67e-4
Target (%)	0.631	1.51	3.14	5.69	8.95	12.23	14.49	14.9	13.3	10.31	6.94	4.06	2.07	0.919
X space transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Y space transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Unreacted in material (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Q (Charge) ratio (%)	0.631	1.51	3.14	5.69	8.95	12.23	14.49	14.9	13.3	10.31	6.94	4.06	2.07	0.919
Unstopped in material (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
tuning (%)	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96
X angular transmission (%)	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Y angular transmission (%)	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96	97.96

The Quad field minimization utility is expected to be developed in LISE++ in 2015!!

Transmission through the slits 3 about 92% for the setting ion (vertical cut)

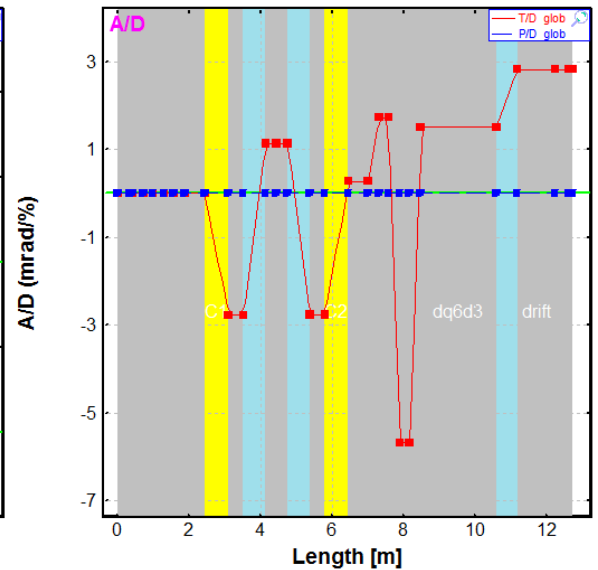
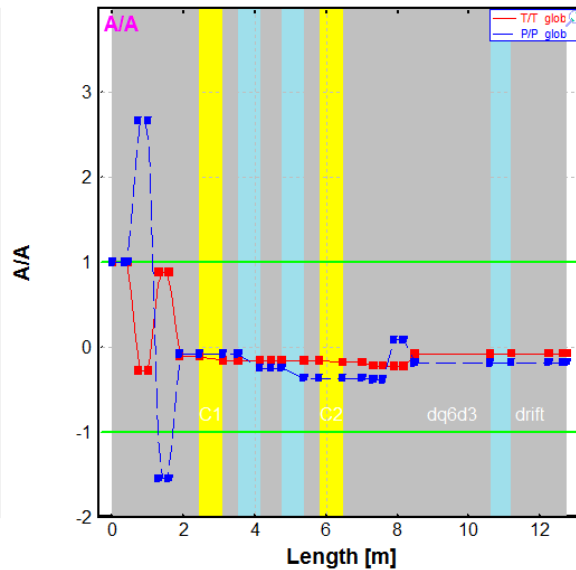
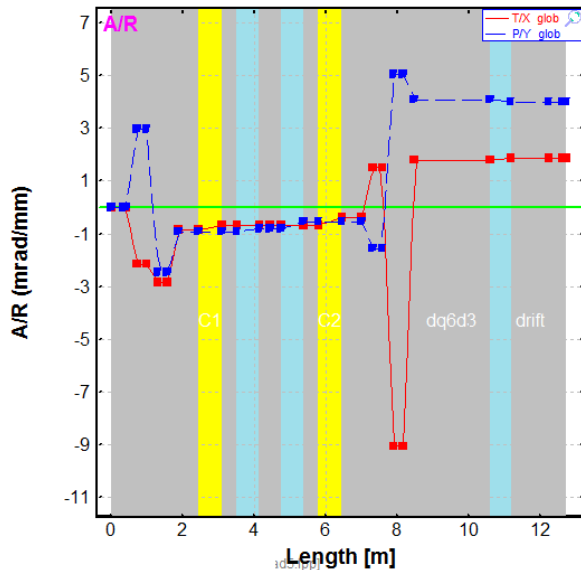
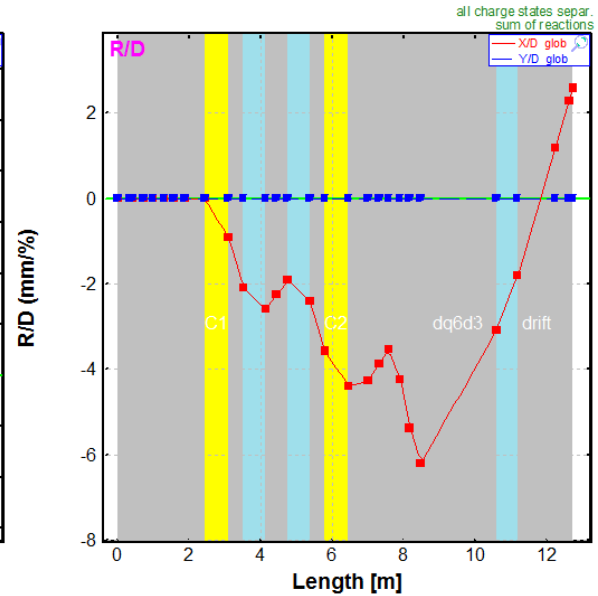
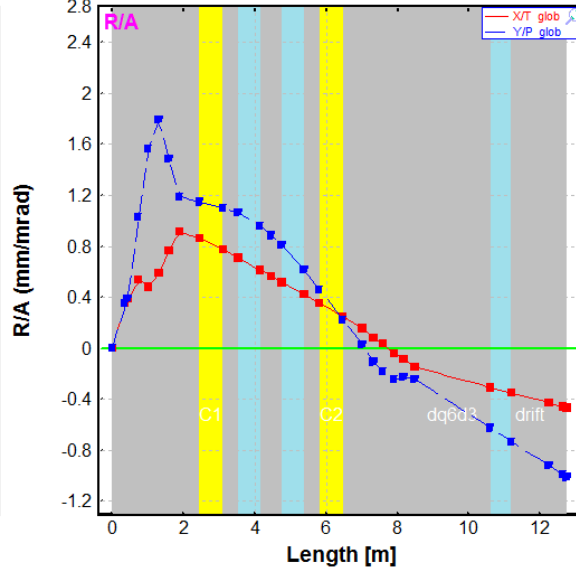
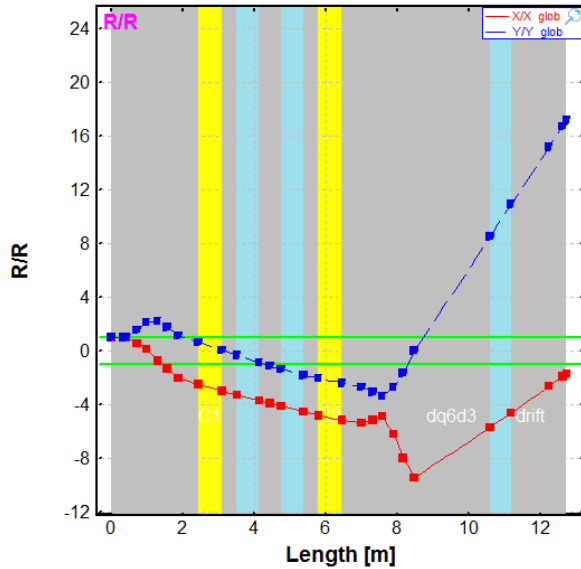
slits 4 were not used

Configurations : Q5 field value modification

First order matrix elements

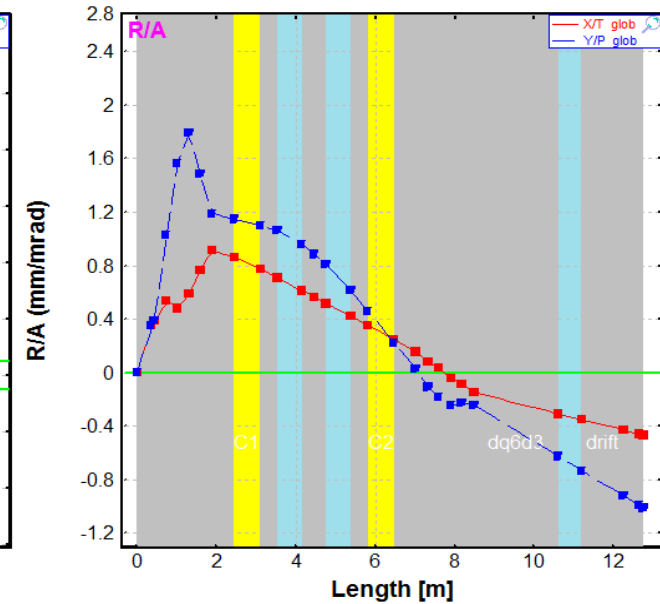
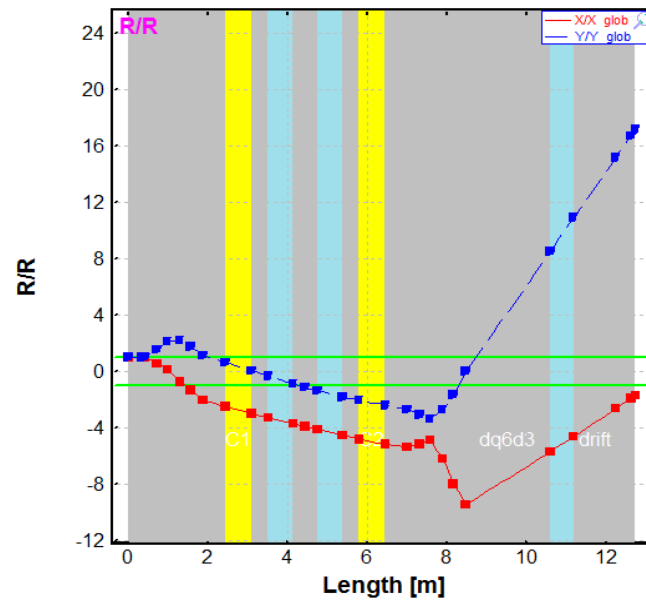
SHELS v9 brho_quad5.lpp

^{50}Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on $^{256}\text{Rf}^{20+..20+}$; Config: DSSSSSSSSSESDSSSDSESSSSSSSS...
 dp/p=67.77% ; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489



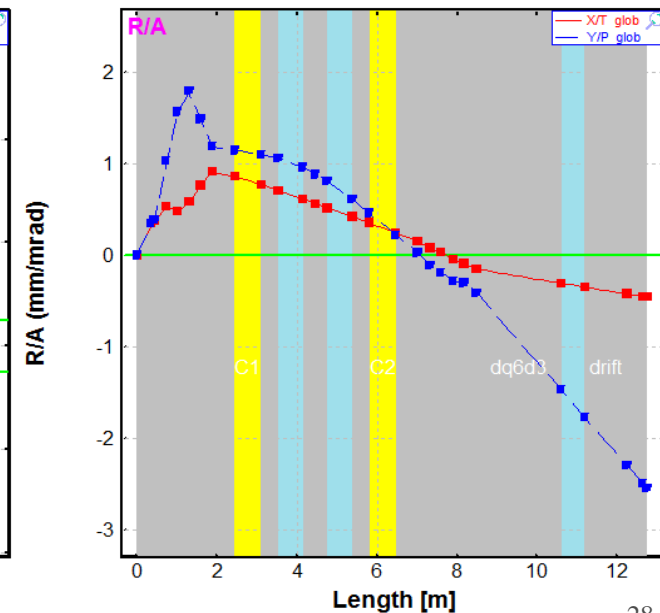
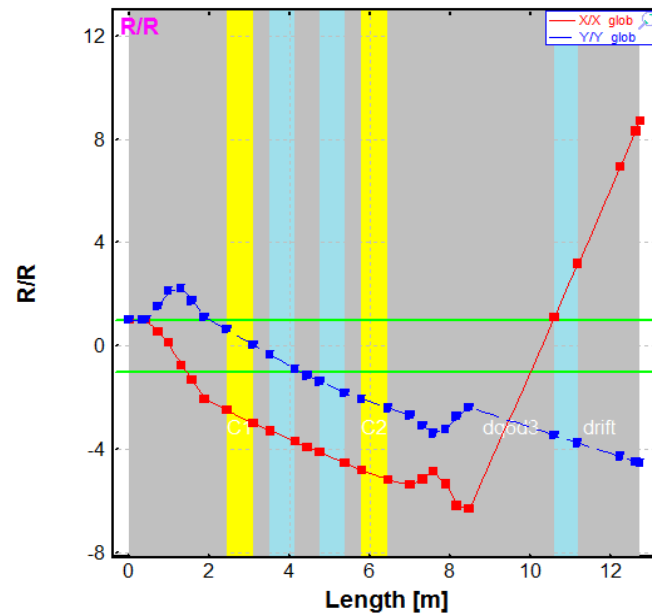
SHELS v9 brho_quad5.lpp

Settings with Brho and Q5 field modifications



SHELS v9.lpp

Experimental (logbook) settings

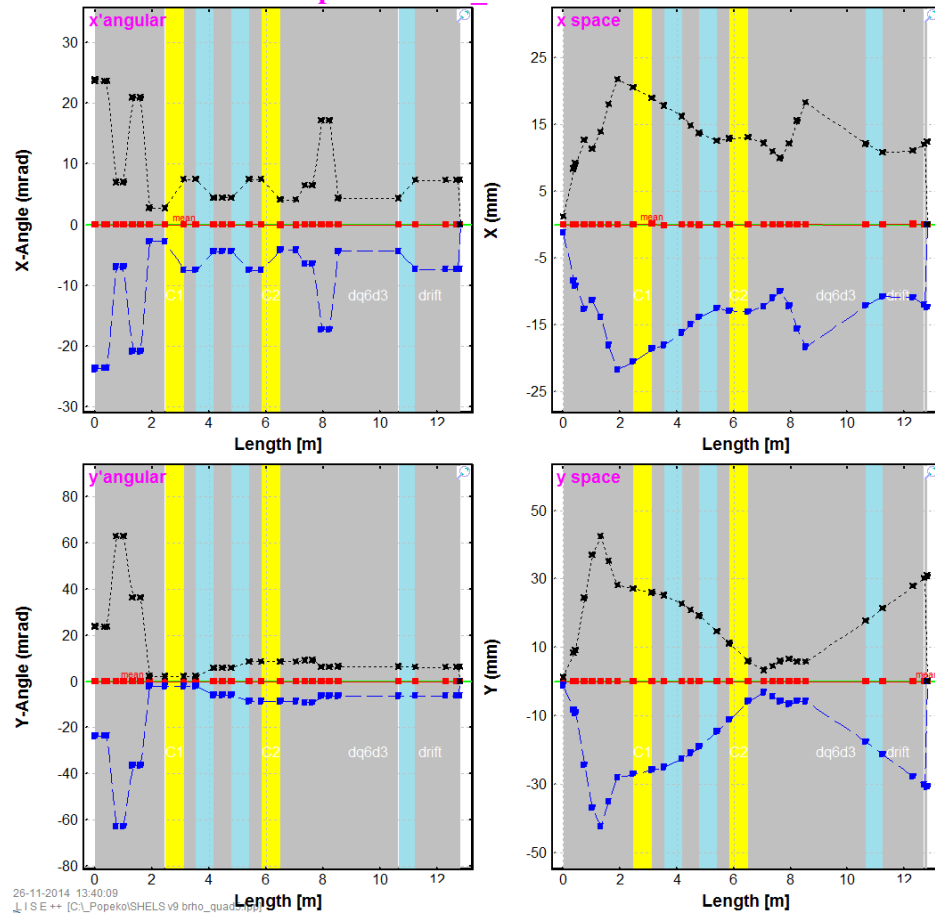


Analytical solution

[SHELS v9 brho_quad5.lpp](#)

Settings with Brho and Q5 field modifications

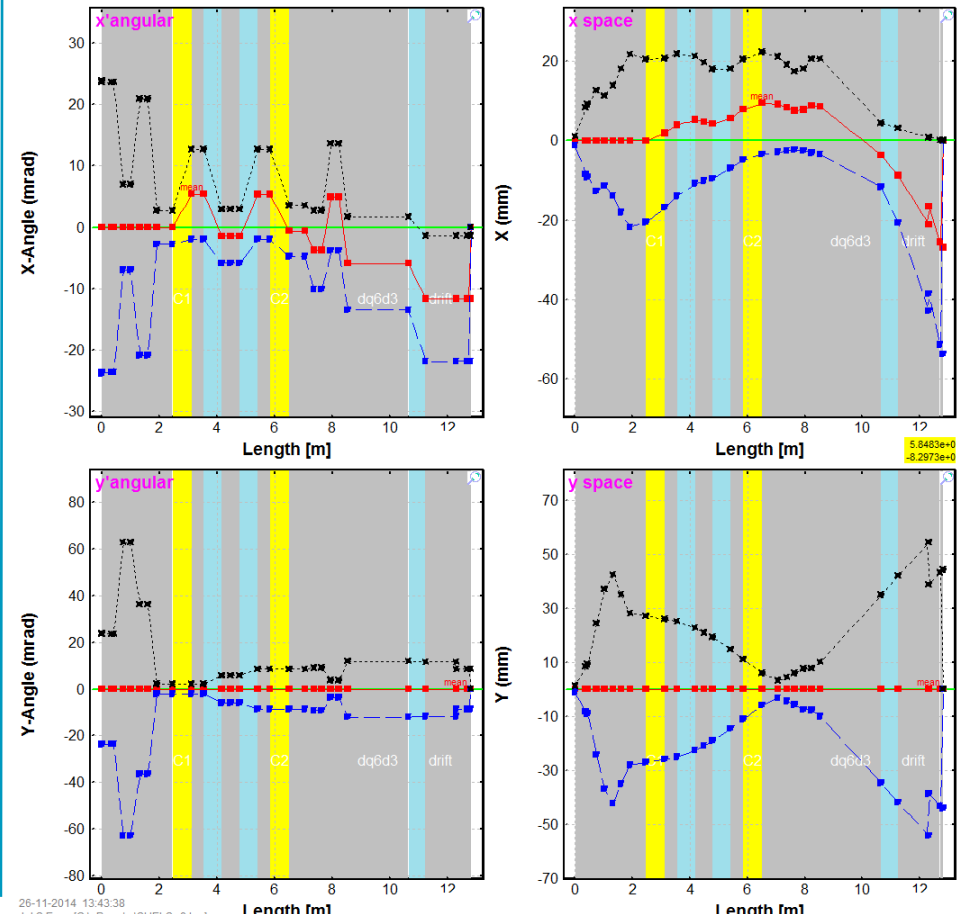
Envelope for ^{256}Rf FusRes 20+ 20+ 20+ 20+ 20+ 20+



[SHELS v9.lpp](#)

Experimental (logbook) settings

Envelope for ^{256}Rf FusRes 20+ 20+ 20+ 20+ 20+ 20+



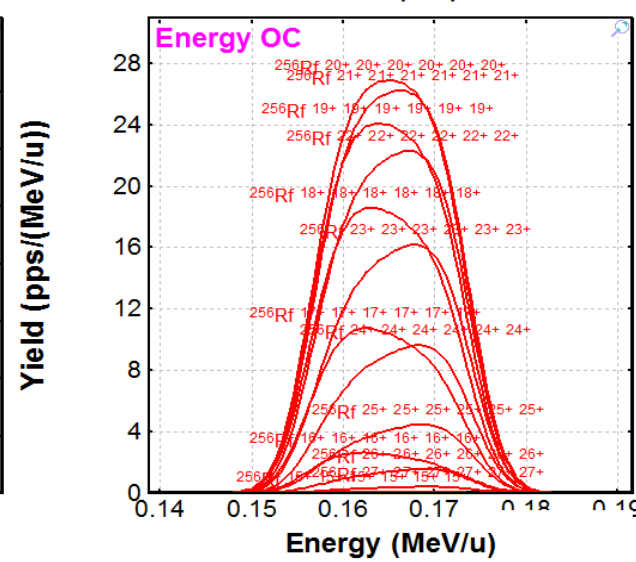
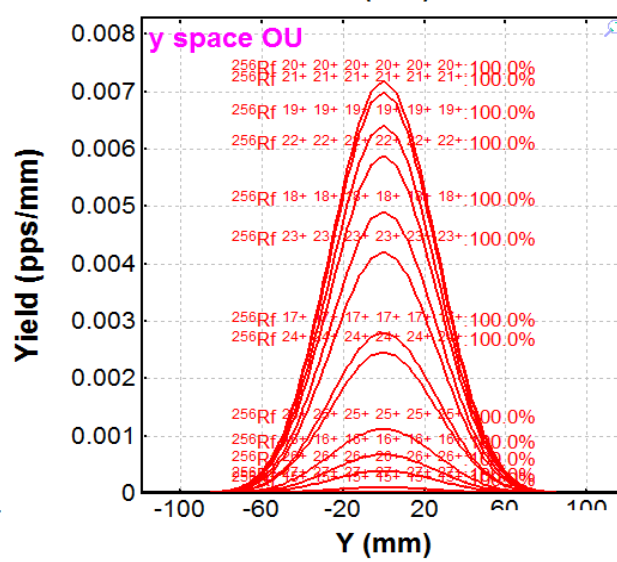
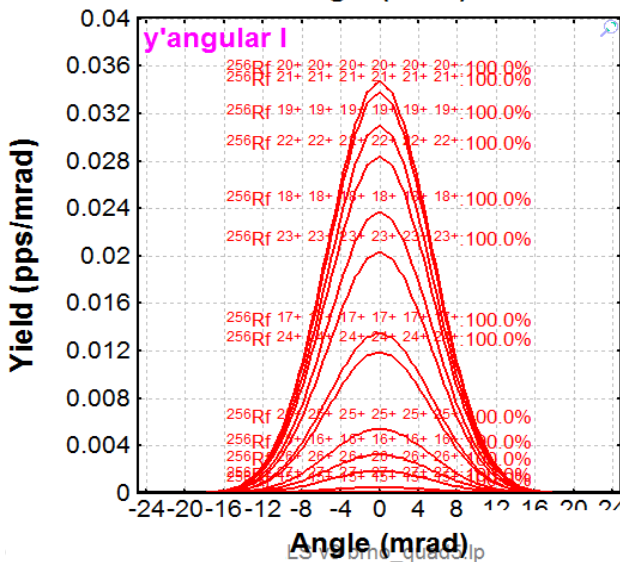
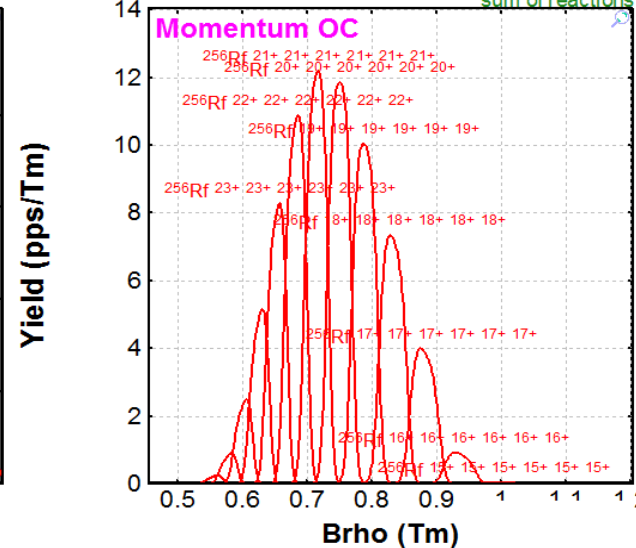
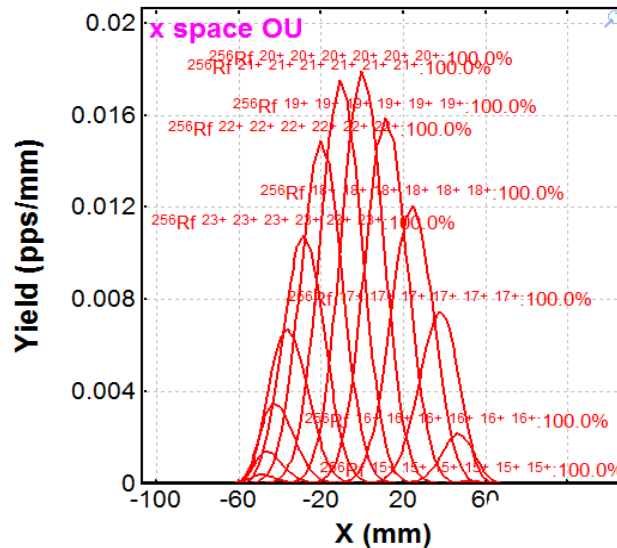
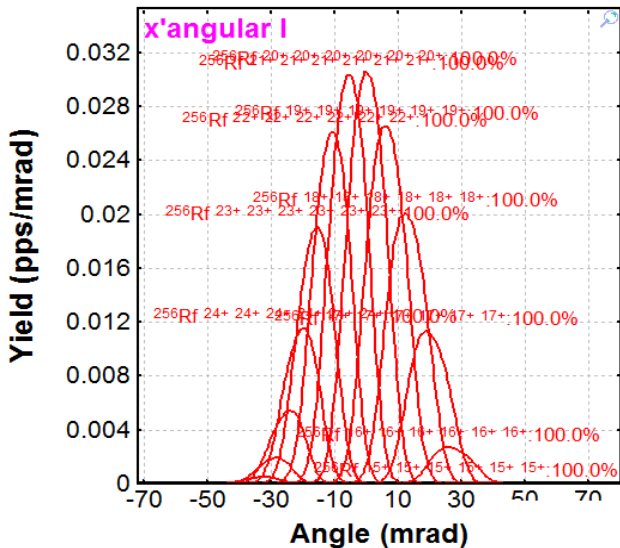
Analytical solution

SHELS v9 brho_quad5.lpp

slits 4

^{50}Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on $^{256}\text{Rf}^{20+..20+}$;
 dp/p=67.77% ; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489

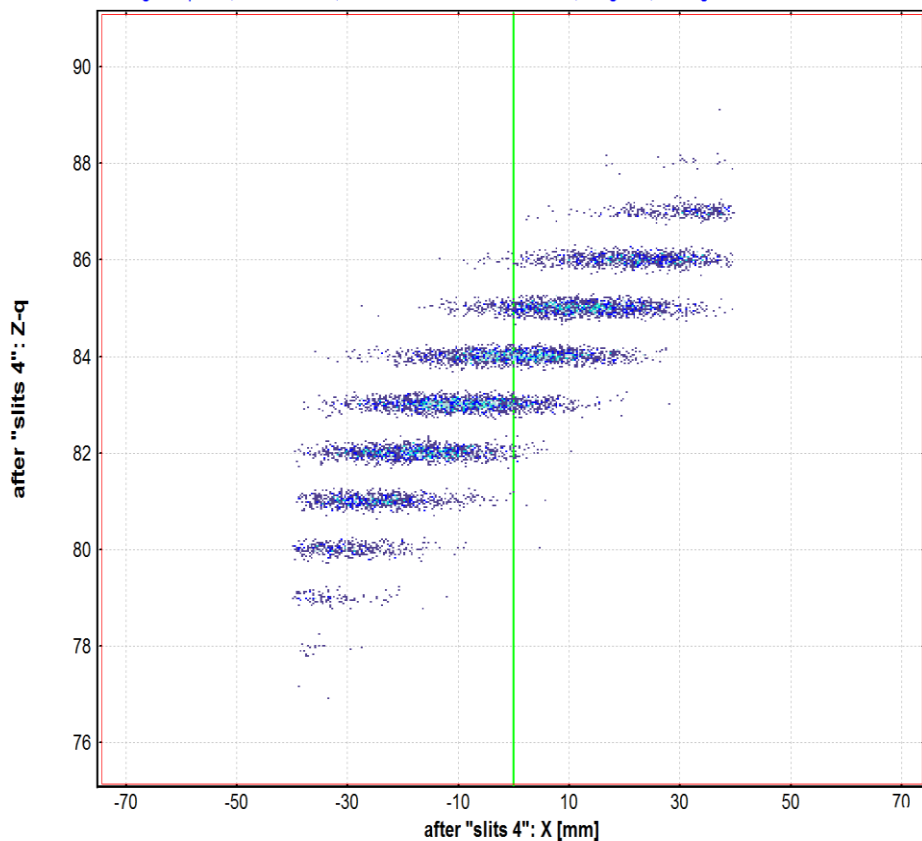
all charge states separ.
sum of reactions



Isotope Group : Monte Carlo Yield Plot

^{50}Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Transmitted Fragment $^{256}\text{Rf}^{20+}$ (FusRes); Optics Order:
dp/p=67.77% ; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489

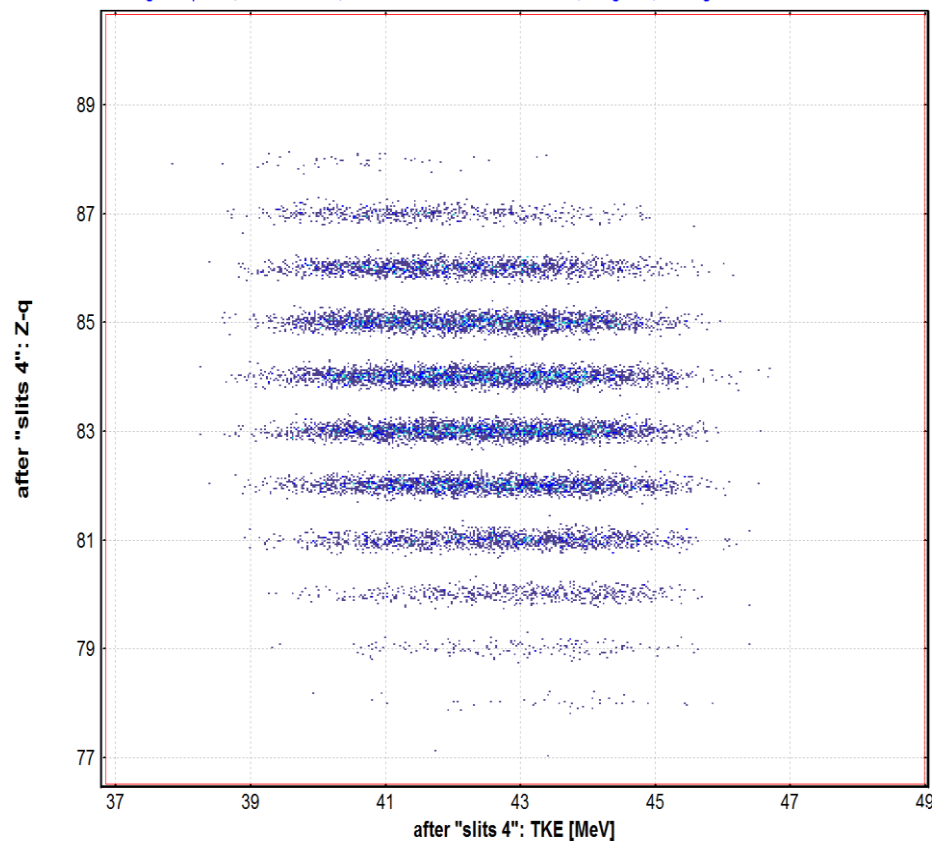
AngAccept: Off; Bounds: ON; "slits 4" - last block for MC calc; no gates; Config: DSSSSSSSSSESDSSDSE



Isotope Group : Monte Carlo Yield Plot

^{50}Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Transmitted Fragment $^{256}\text{Rf}^{20+}$ (FusRes); Optics Order:
dp/p=67.77% ; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489

AngAccept: Off; Bounds: ON; "slits 4" - last block for MC calc; no gates; Config: DSSSSSSSSSESDSSDSE



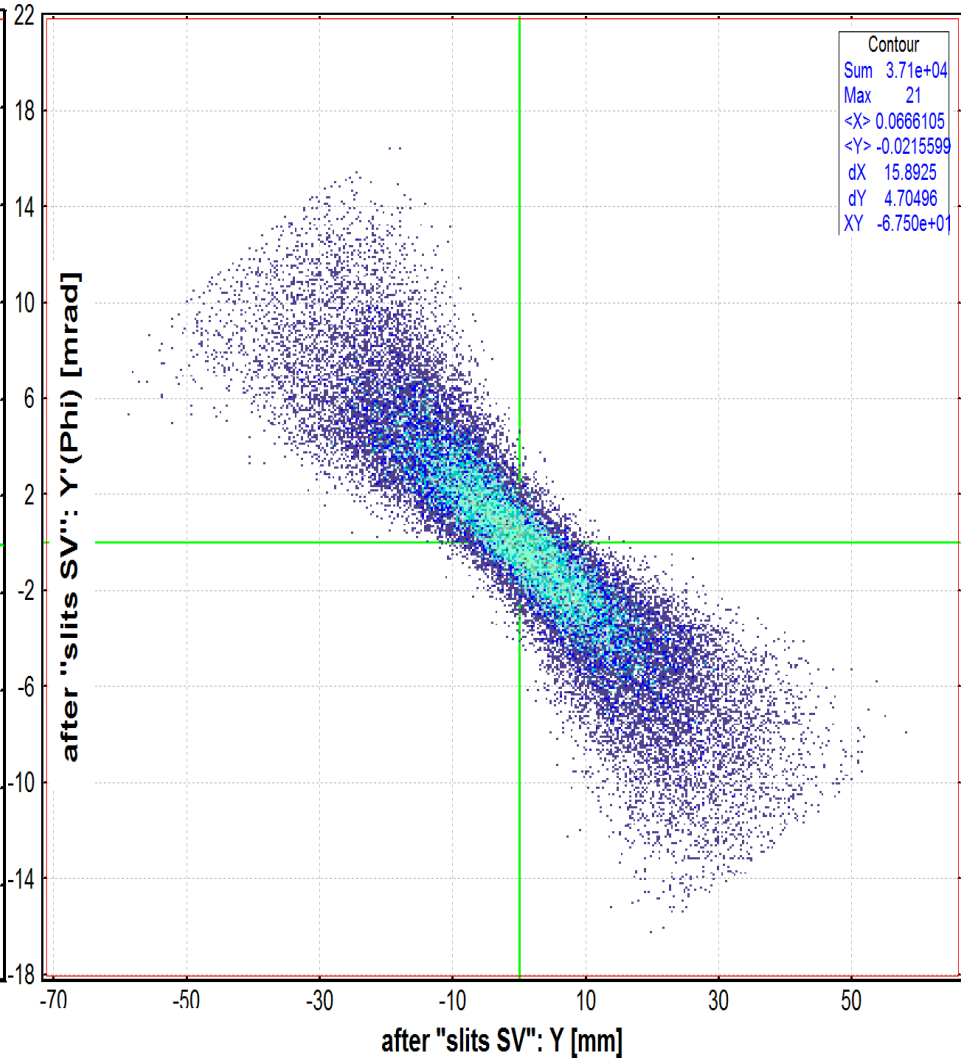
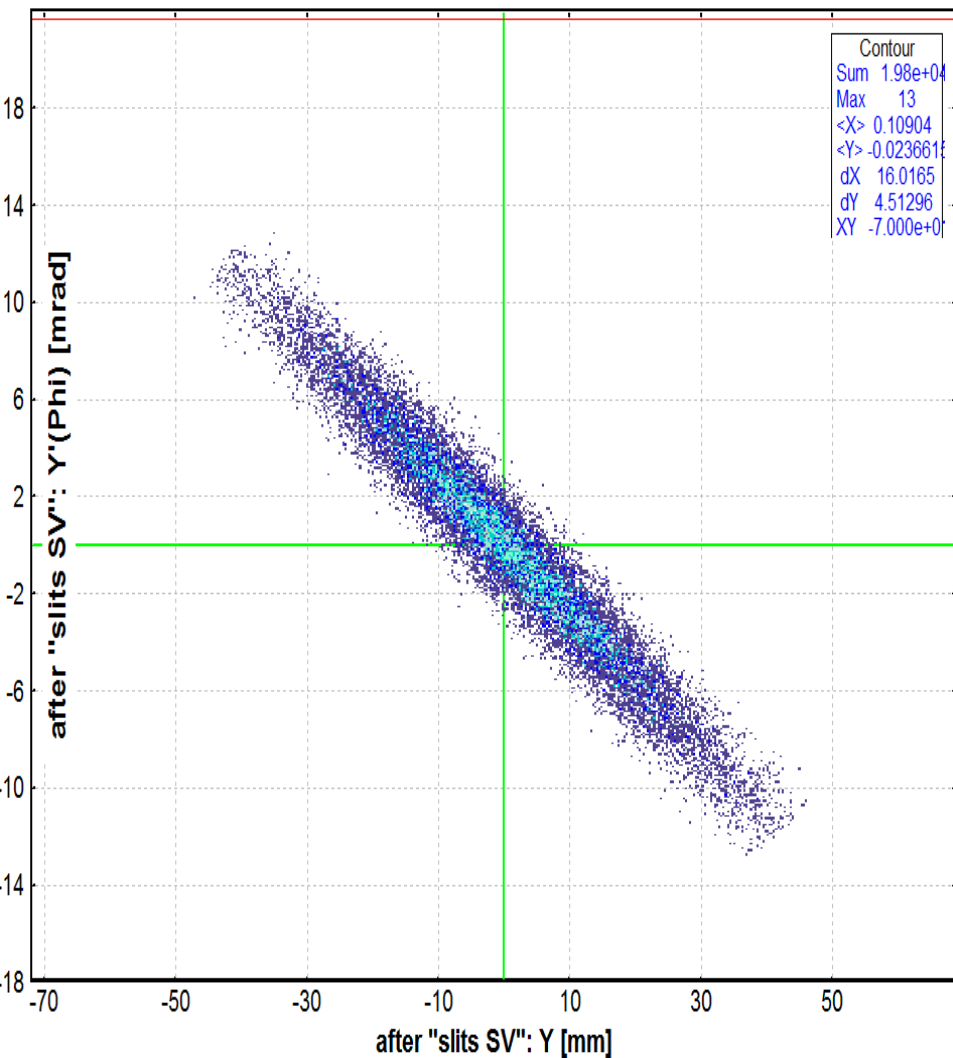
MC solution

Y' vs Y @ the SV slits
256Rf20+

[SHELS v9 brho_quad5.lpp](#)

1st order optics

2nd order optics

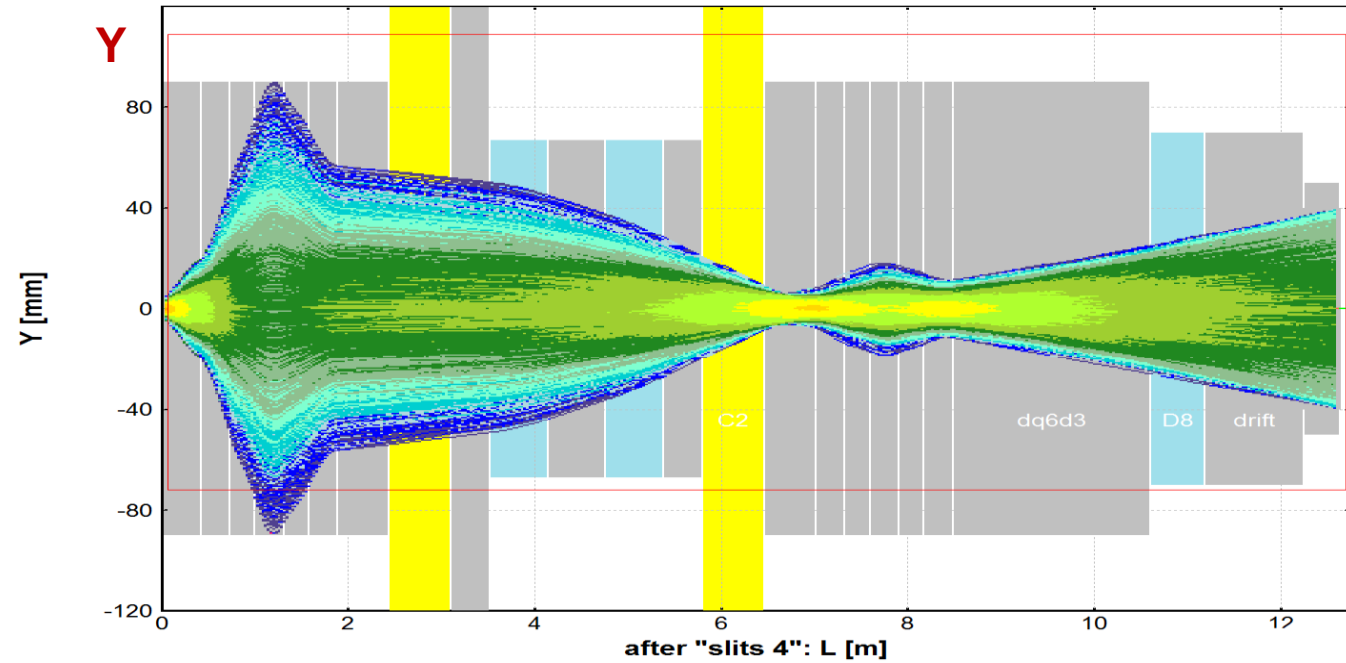
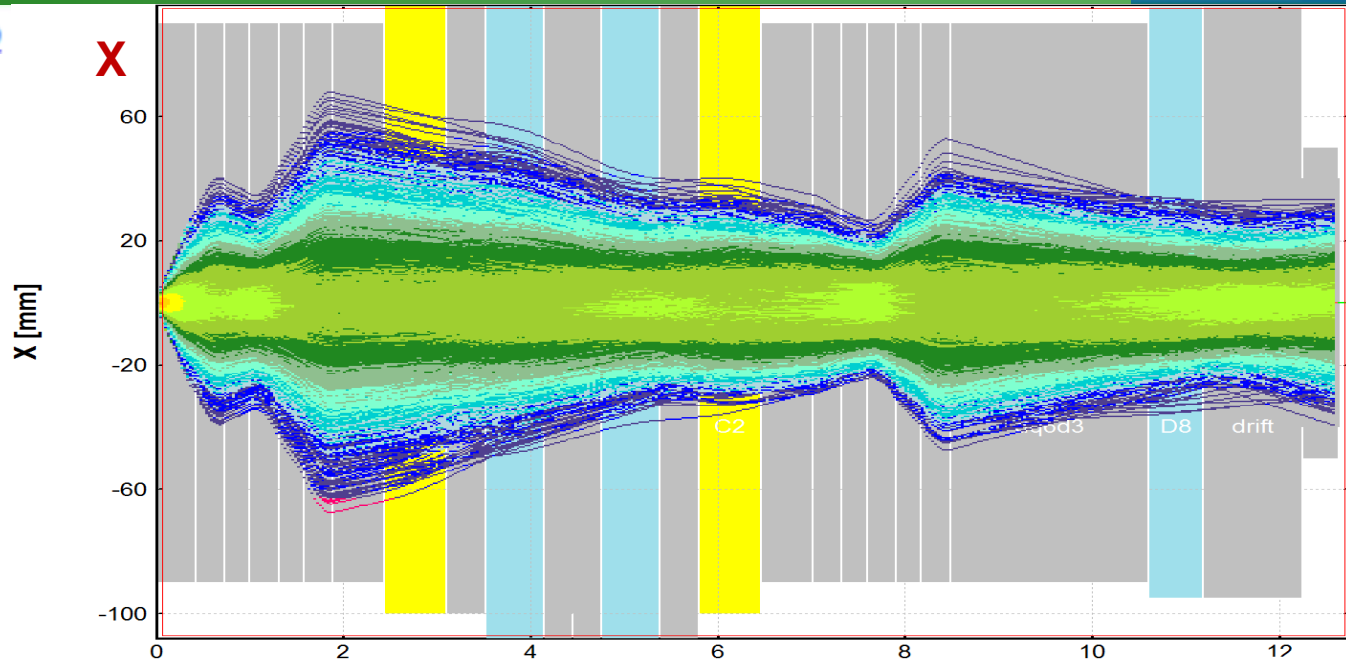


MC solution [SHELS v9 brho_quad5.lpp](#)

X & Y envelopes
of $^{256}\text{Rf}^{20+}$

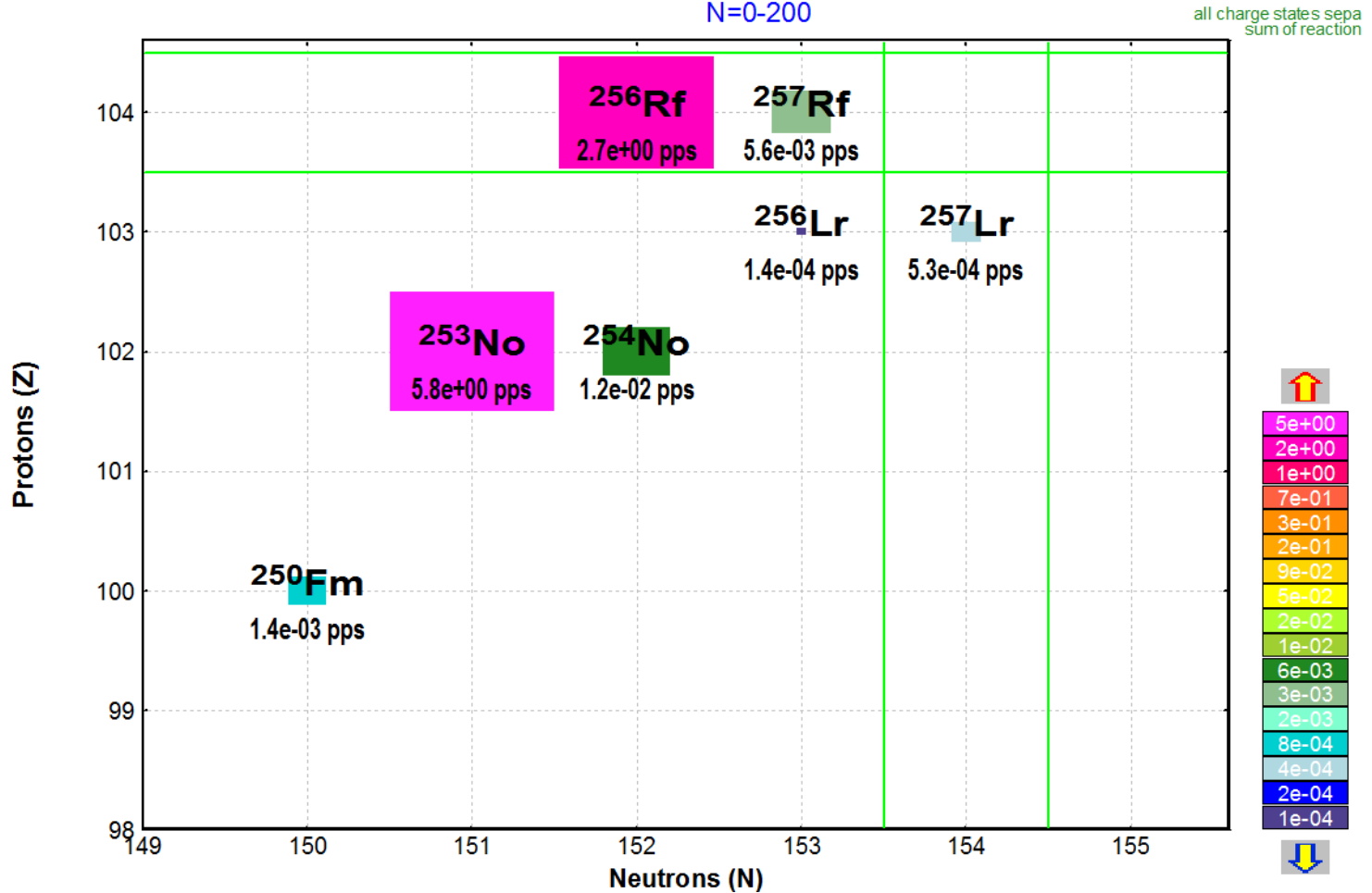
$^{256}\text{Rf}^{20+}$ transmission
(without charge state coefficient)
86.6%

No slits 4 in use



[3] Total: All reactions (pps)

^{50}Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on $^{256}\text{Rf}^{20+..20+}$; Config: DSSSSSSSSSESDSSSDSESSSSS
 dp/p=67.77% ; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489
 N=0-200



Total rate is 8.5 pps / 1 puA

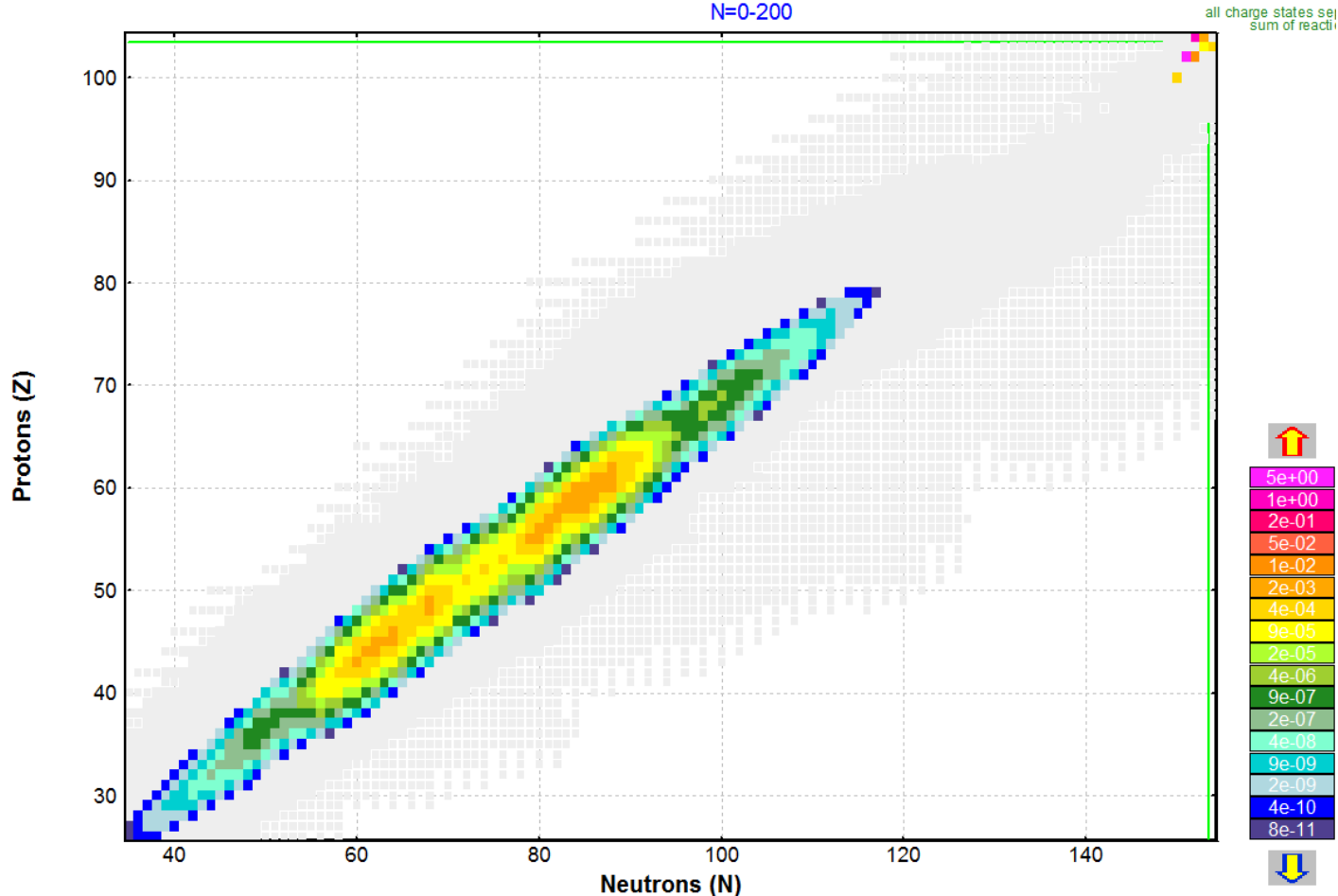
Analytical solution

Fusion-Residues +
Fusion-Fission products

File (link) :
[SHELS v9 brho_quad5 fission.lpp](#)

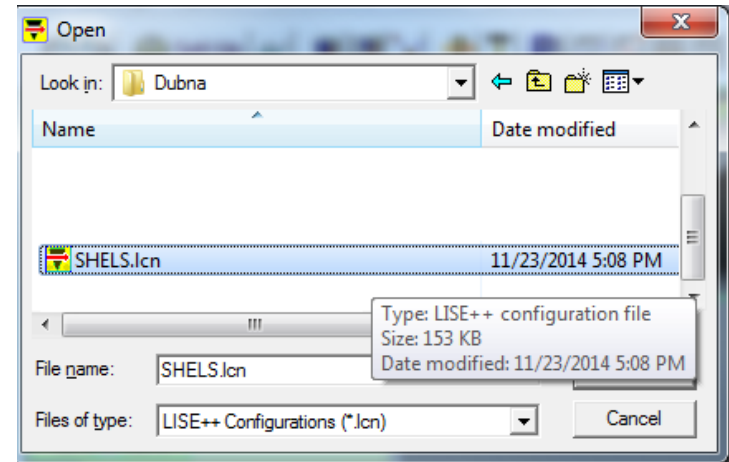
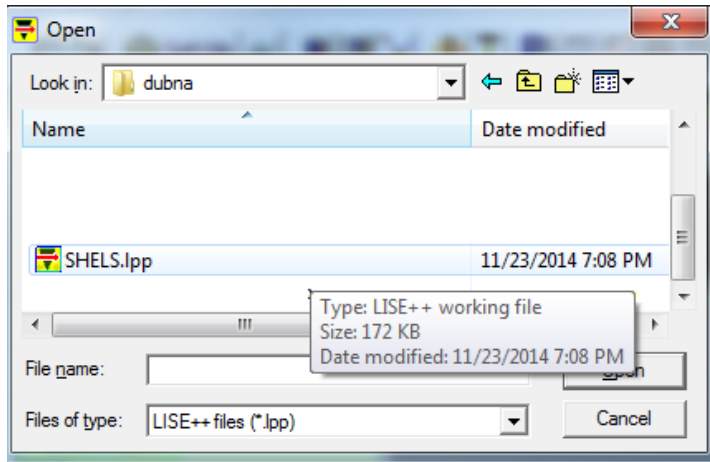
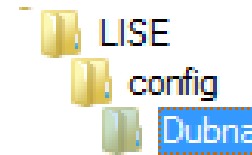
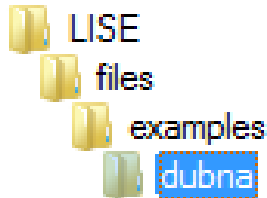
[3] Total: All reactions (pps)

⁵⁰Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on ²⁵⁶Rf²⁰⁺.₂₀₊; Config: DSSSSSSSSSESDSSSDSESSSSSSSS...
dp/p=67.78% ; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489
N=0-200



Total rate is
8.7 pps / 1 puA

[SHELS.lpp](#) [SHELS.lcn](#) are based on [SHELS v9 brho quad5.lpp](#)



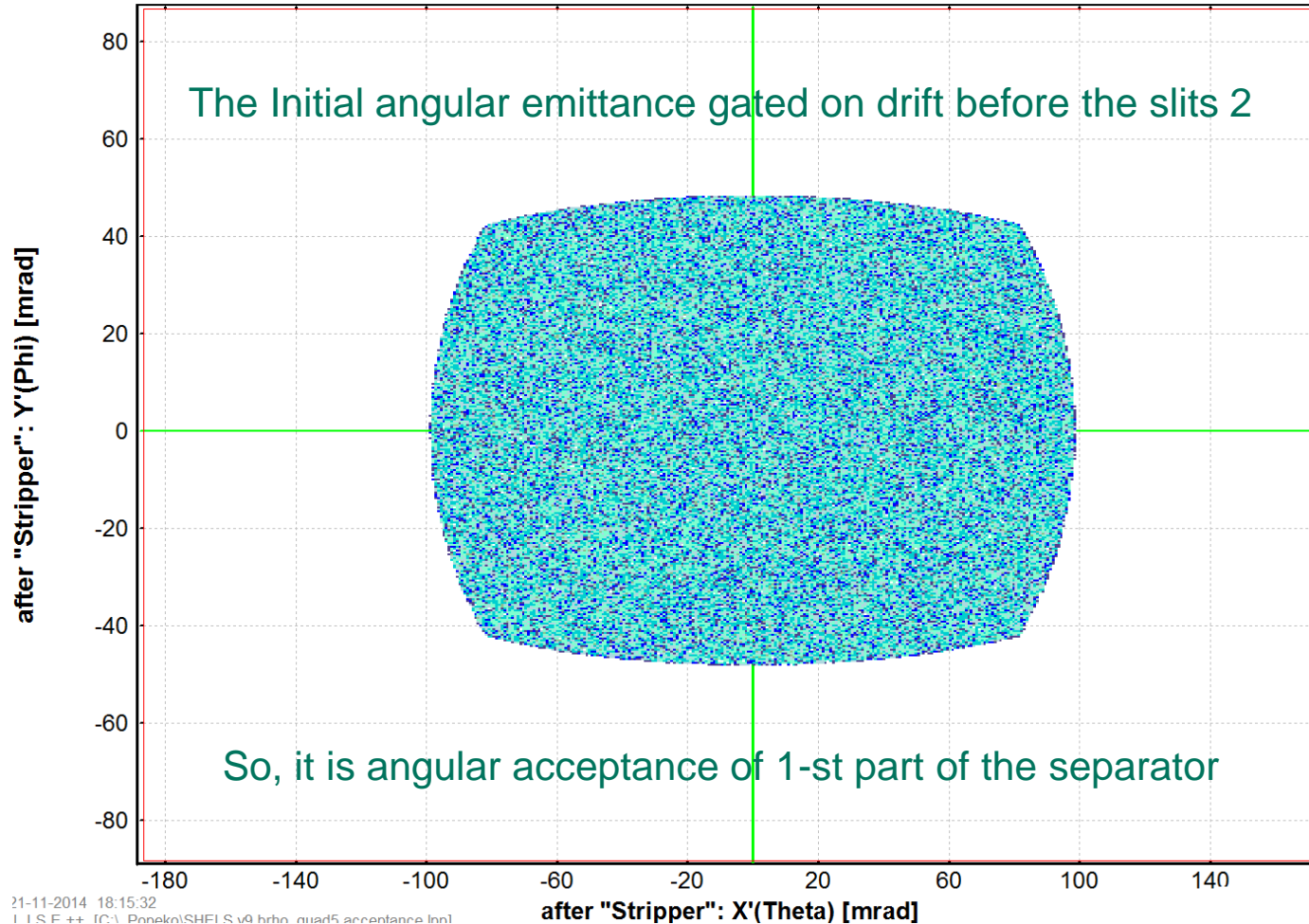
File: [SHELS v9 brho_quad5 acceptance.lpp](#)

^{50}Ti : Monte Carlo Transmission Plot

^{50}Ti (4.3 MeV/u) + ; Transmitted Fragment $^{50}\text{Ti}^{20+..20+}$ (beam); Optics Order: 1
 $dp/p=21.94\%$; Brho(Tm) : 0.7489, 0.7489, 0.7489, 0.7489

AngAccept: Off; Bounds: ON; "dd1sv" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSSSES

Emittance		
	Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X	mm 0.01	Gaussian
2. T	mrad 150	Rectangle uniform
3. Y	mm 0.01	Gaussian
4. P	mrad 150	Rectangle uniform
5. L	mm 0	Gaussian
6. D	% 0.0001	Gaussian



21-11-2014 18:15:32
 L I S E ++ (C:\Poneko\SHELS v9 brho_quad5 acceptance.lpp)

Angular Acceptance of the 1s-t half of separator

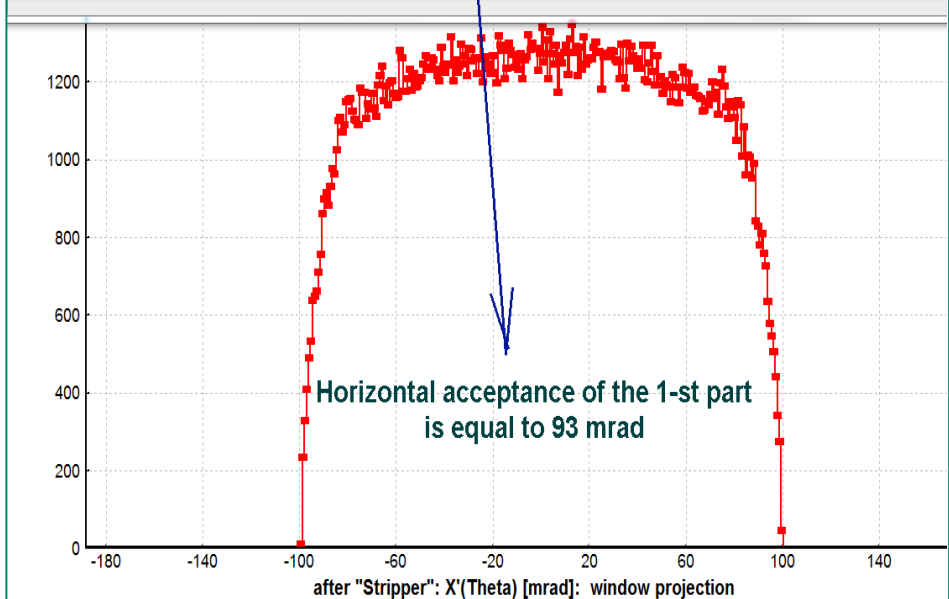
50Ti : Monte Carlo Transmission Plot

after "Stripper": X'(Theta) [mrad]: window projection --- ⁵⁰Ti (4.3 MeV/u) + ; Transmitted Fragment ⁵⁰Ti^{20+..20+} (beam); Optics Order: 1
 dp/p=21.94%; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489

AngAccept: Off; Bounds: ON: "dd1sv" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSSSESDDSSSSSES

Monte Carlo Transmission Plot
 after "Stripper": X'(Theta) [mrad]: window projection --- ⁵⁰Ti (4.3 MeV/u) + ; Transmitted Fragment ⁵⁰Ti^{20+..20+} (beam); Optics Order: 1
 dp/p=21.94%; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489
 AngAccept: Off; Bounds: ON: "dd1sv" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSSSESDDSSSSSES

distribution	x-mean	x-max	y-max	deviation	FWHM	area	SumOfCounts	LeftPsigma	RightPsigma
	+4.3269e-01	+1.3087e+01	1.346e+03	5.330e+01	1.863e+02	2.2666e+05	2.765e+05	8.962e+01	6.863e+01



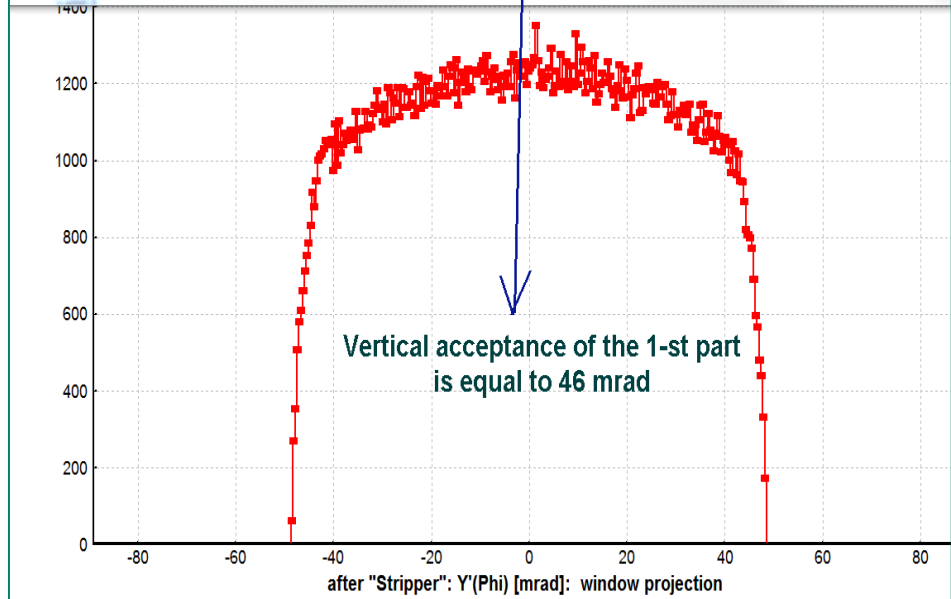
50Ti : Monte Carlo Transmission Plot

after "Stripper": Y'(Phi) [mrad]: window projection --- ⁵⁰Ti (4.3 MeV/u) + ; Transmitted Fragment ⁵⁰Ti^{20+..20+} (beam); Optics Order: 1
 dp/p=21.94%; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489

AngAccept: Off; Bounds: ON: "dd1sv" - last block for MC calc; Gate 1: "AND" (Y [mm]); Config: DSSSSSSSESDDSSSSSES

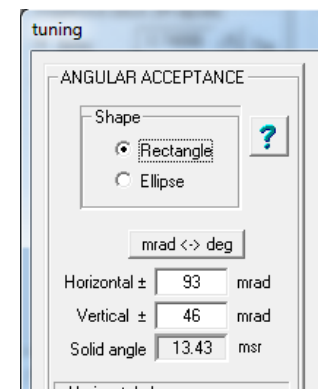
Monte Carlo Transmission Plot
 after "Stripper": Y'(Phi) [mrad]: window projection --- ⁵⁰Ti (4.3 MeV/u) + ; Transmitted Fragment ⁵⁰Ti^{20+..20+} (beam); Optics Order: 1
 dp/p=21.94%; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489
 AngAccept: Off; Bounds: ON: "dd1sv" - last block for MC calc; Gate 1: "AND" (Y [mm]); Config: DSSSSSSSESDDSSSSSES

distribution	x-mean	x-max	y-max	deviation	FWHM	area	SumOfCounts	LeftPsigma	RightPsigma
	+5.2642e-02	+1.4771e+00	1.349e+03	2.618e+01	9.211e+01	1.0708e+05	2.765e+05	4.036e+01	3.787e+01



Angular acceptance $X' = \pm 93$ mrad, $Y' = \pm 46$ mrad (**Rectangle** shape) has been applied to the "Tuning" dipole.

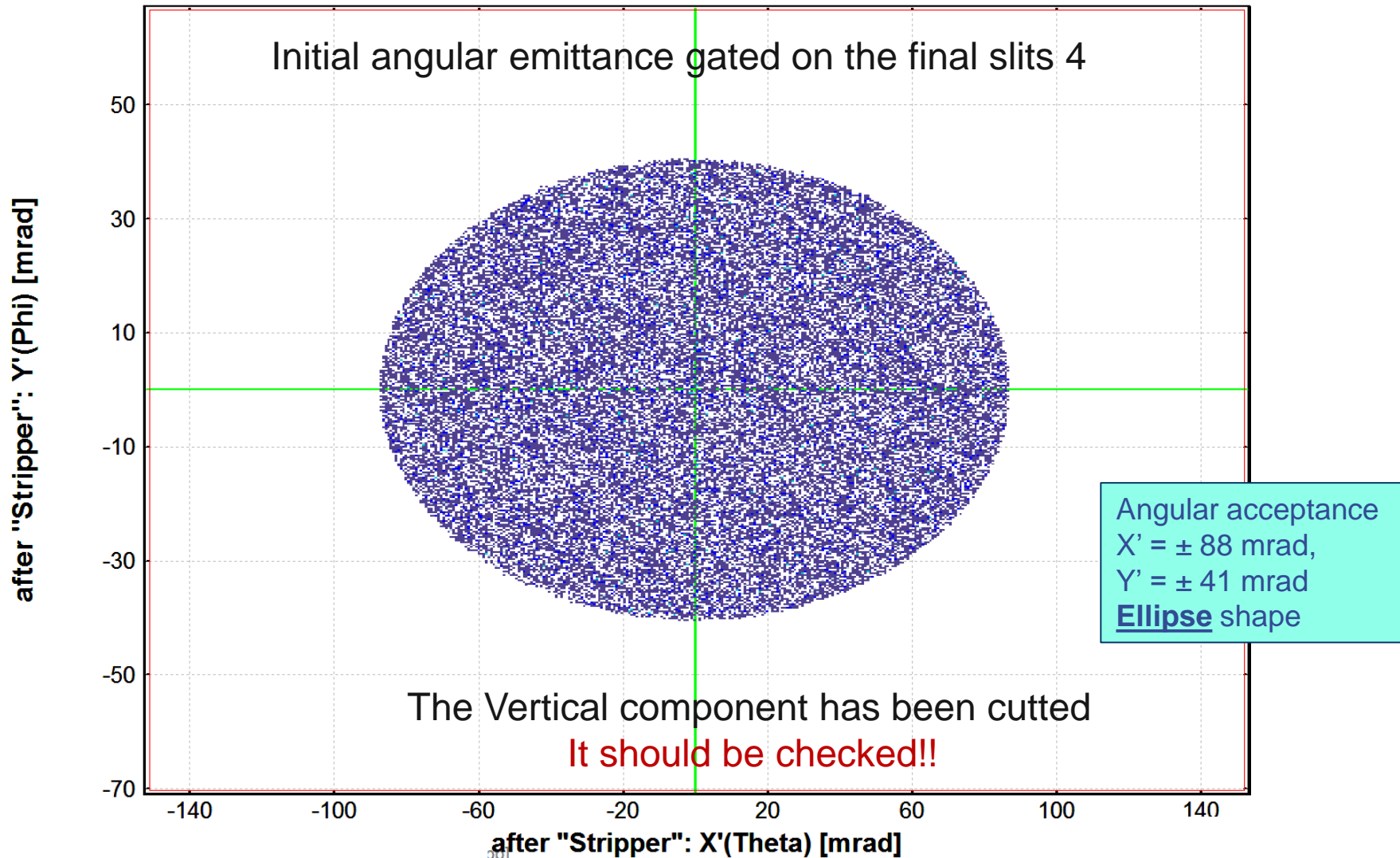
It's important for Analytical transmission calculations ("Distribution" method). The Angular acceptance option can be turned off in the Monte Carlo case.



^{50}Ti : Monte Carlo Transmission Plot

^{50}Ti (0.2 MeV/u) + ; Transmitted Fragment $^{50}\text{Ti}^{4+..4+}$ (beam); Optics Order: 1
dp/p=35.11% ; Brho(Tm): 0.7489, 0.7489, 0.7489, 0.7489

igAccept: Off; Bounds: ON; "slits 4" - last block for MC calc; Gate 1: "AND" (X [mm]); Config: DSSSSSSSS

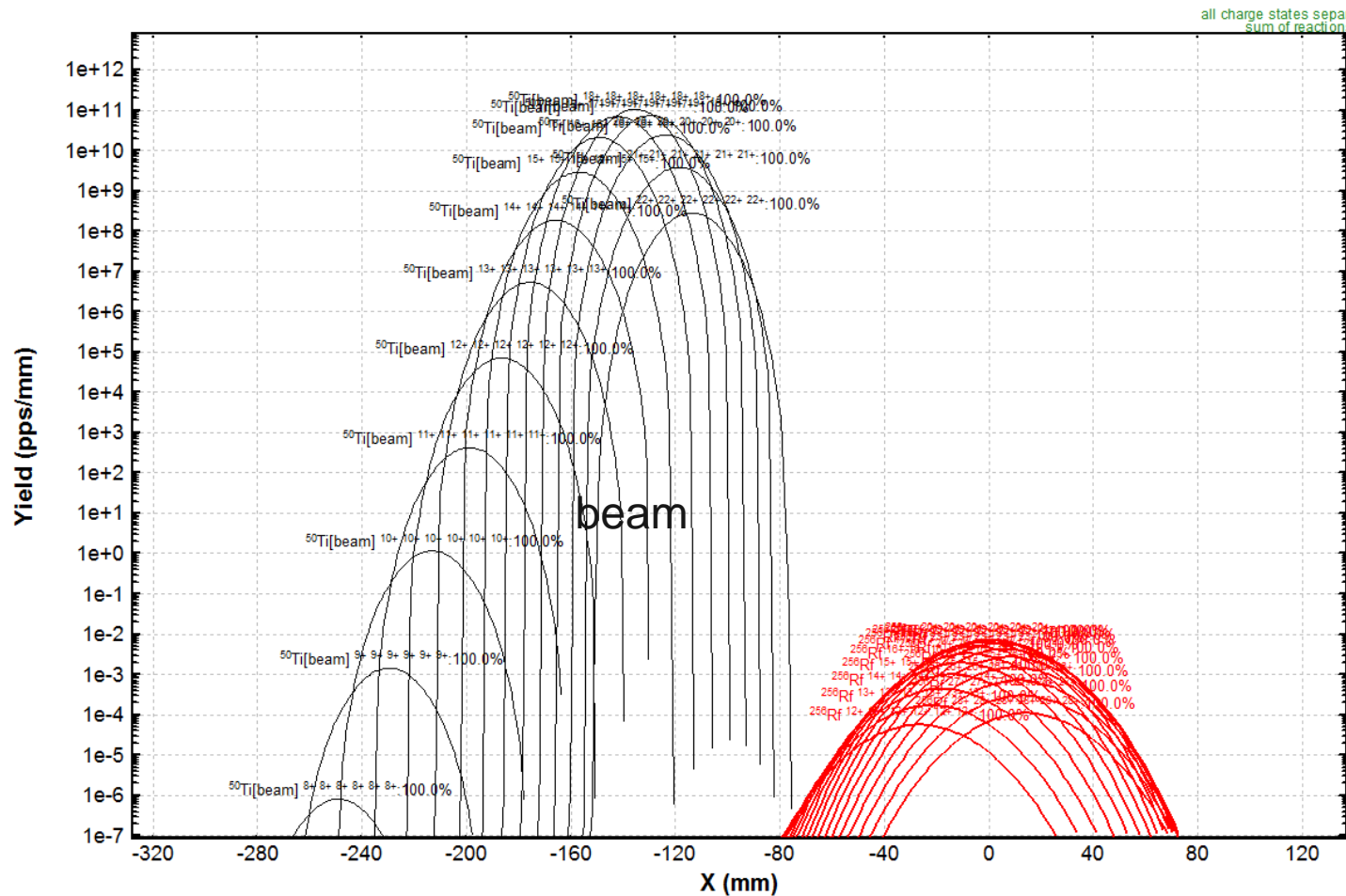




- Target
- Stripper
- tuning
- DTS1
- slits 1
- DS1Q1
- Quad 1
- dqiqk
- Quad 2
- dqiqk
- Quad 3
- dq3c1
- C1
- dc1d1
- D22_1
- dd1sv
- slits SV
- dsvd2
- D22_2
- dd2c2
- C2
- dc2q4
- Quad 4
- dqiqk
- Quad 5
- dqiqk
- Quad 6
- dq6d3
- D8
- drift
- slits 3
- drift
- slits 4
- drift
- Material 1

C1 : Beam & SetFragment Charge States

^{50}Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on $^{256}\text{Rf}^{20+..20+}$; Config: DSSSSSSSSEA
 dp/p=100.00% ; Brho(Tm): 0.7489



all charge states separ
sum of reactions

- Target
- Stripper
- tuning
- DTS1
- slits 1
- DS1Q1
- Quad 1
- dqiqk
- Quad 2
- dqiqk
- Quad 3
- dq3c1
- C1
- dc1d1
- D22_1
- dd1sv
- slits SV
- dsvd2
- D22_2
- dd2c2
- C2
- dc2q4
- Quad 4
- dqiqk
- Quad 5
- dqiqk
- Quad 6
- dq6d3
- D8
- drift
- slits 3
- drift
- slits 4
- drift
- Material 1

D22_1 : Beam & SetFragment Charge States

^{50}Ti (4.7 MeV/u) + PbS (0.41 mg/cm²); Settings on $^{256}\text{Rf}^{20+..20+}$; Config: DSSSSSSSSSESDA
 dp/p=100.00% ; Brho(Tm) : 0.7489, 0.7489

