2^{nd} order Electrostatic Dipole in LISE^{++}

Version 9.10.298
from 06/06/2016

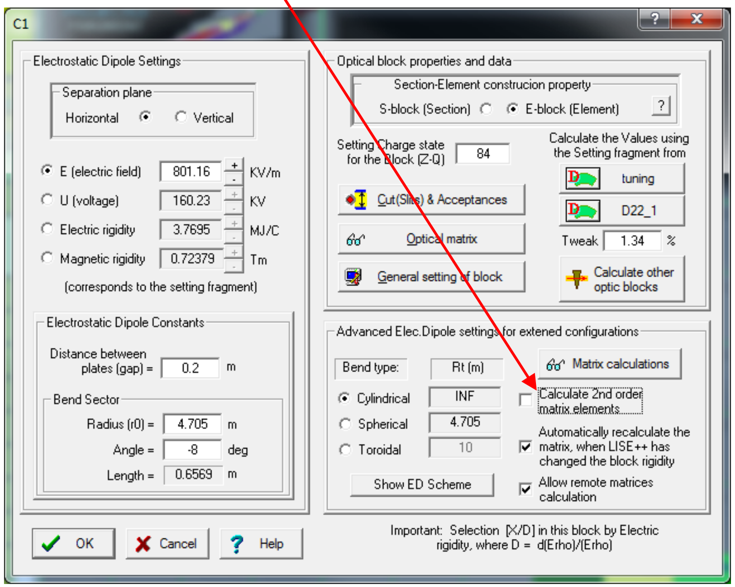
The 2^{nd} order approximation equations in C-format were provided by **Robert Hipple** (Department of Physics and Astronomy, Michigan State University) based on **H.Wollnik**'s work NIM 34 (1965) 213-221

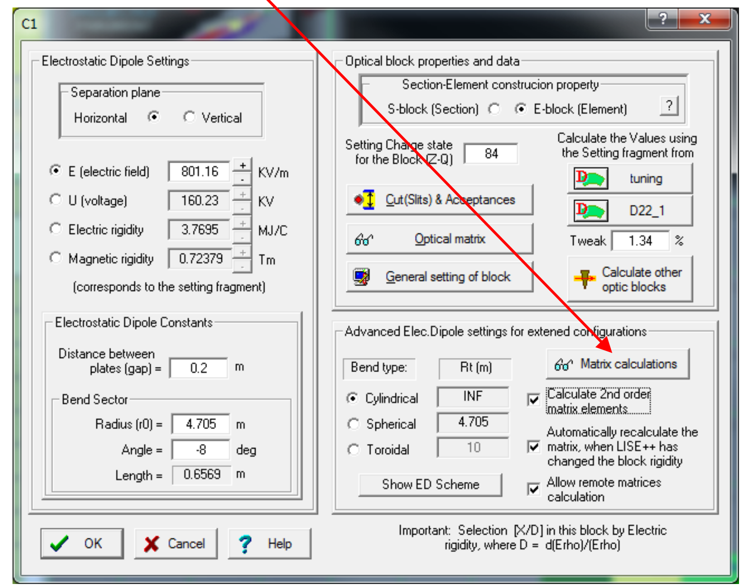
- 2^{nd} order settings for already existed configuration
- Comparison between COSY & LISE calculations for electric dipoles
- Using 2^{nd} order electrostatic dipoles in EMMA @ TRIUMF
- Using 2^{nd} order electrostatic dipoles in SHELS @ FLNR/JINR
- Outlook

2nd order E.D. settings for already existed configuration

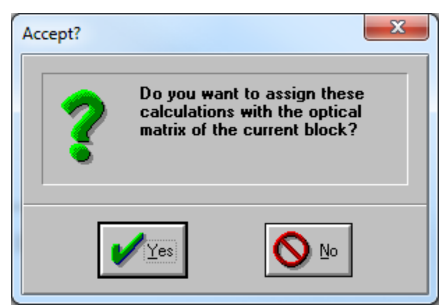
1st step: set "checked" the 2nd order box

2nd step: click "Matrix calculations" button





3rd step: Accept calculations



Comparison between COSY & LISE calculations for electric dipoles

"Cylindrical" type; Radius = 1 m; Angle = 20 deg

LISE

Block: "ElecDipole" Matrices: "LOCAL"

transport format [cm-mrad]

* TRANSFORM 1 *

1 [X]:	+8.8064e-01	+3.3510e-02	0	0	0	+1.1936e-01
2 [T]:	-6.6995e+00	+8.8064e-01	0	0	0	+6.6995e+00
3 [Y]:	0	0	+1.0000e+00	+3.4910e-02	0	0
4 [F]:	0	0	0	+1.0000e+00	0	0
5 [L]:	-6.6995e-01	-1.1940e-02	0	0	+1.0000e+00	-2.8000e-02
6 [D]:	0	0	0	0	0	+1.0000e+00

* TRANSFORM 2 *

1	1:	-2.8189e-03					
1	2:	+5.7678e-04	+5.1381e-06				
1	3:	0	0	0			
1	4:	0	0	0	-5.9697e-06		
1	5:	0	0	0	0	0	
1	6:	+5.6350e-03	+9.3310e-05	0	0	0	-1.6237e-03
2	1:	-8.9888e-02					
2	2:	-4.3966e-03	-5.3350e-05				
2	3:	0	0	0			
2	4:	0	0	0	-3.3506e-04		
2	5:	0	0	0	0	0	
2	6:	+1.5725e-01	+4.3938e-03	0	0	0	-1.2329e-01
3	1:	0					
3	2:	0	0				
3	3:	0	0	0			
3	4:	+6.7013e-04	+1.1939e-05	0	0		
3	5:	0	0	0	0	0	
3	6:	0	0	0	+2.8004e-05	0	0
4	1:	0					
4	2:	0	0				
4	3:	0	0	0			
4	4:	-1.1936e-03	+3.3506e-04	0	0		
4	5:	0	0	0	0	0	
4	6:	0	0	0	+1.1936e-03	0	0
5	1:	0					
5	2:	0	0				
5	3:	0	0	0			
5	4:	0	0	0	0		
5	5:	0	0	0	0	0	
5	6:	0	0	0	0	0	0

COSY

: "ElecDipole" Matrices: "LOCAL"

transport format [cm-mrad]

* TRANSFORM 1 *

X]:	+8.8073e-01	+3.3510e-02	0	0	0	+1.1927e-01
T]:	-6.6943e+00	+8.8073e-01	0	0	0	+6.6943e+00
Y]:	0	0	+1.0000e+00	+3.4910e-02	0	0
F]:	0	0	0	+1.0000e+00	0	0
L]:	-6.6943e-01	-1.1930e-02	0	0	+1.0000e+00	-2.7950e-02
D]:	0	0	0	0	0	+1.0000e+00

* TRANSFORM 2 *

1:	-2.8145e-03					
2:	+5.7693e-04	+5.1394e-06				
3:	0	0	0			
4:	0	0	0	-5.9698e-06		
5:	0	0	0	0	0	
6:	+5.6290e-03	+9.3219e-05	0	0	0	-1.6231e-03
1:	-3.0744e-02					
2:	-1.0955e-03	-3.4837e-04				
3:	0	0	0			
4:	0	0	0	-3.3507e-04		
5:	0	0	0	0	0	
6:	+1.9537e-01	+1.0955e-03	0	0	0	-9.7759e-02
1:	0					
2:	0	0				
3:	0	0	0			
4:	+6.7015e-04	+1.1939e-05	0	0		
5:	0	0	0	0	0	
6:	0	0	0	+2.7982e-05	0	0
1:	0					
2:	0	0				
3:	0	0	0			
4:	0	0	0	0		
5:	0	0	0	0	0	
6:	0	0	0	0	0	0
1:	-6.0224e-03					
2:	-3.3386e-04	-2.0081e-05				
3:	0	0	0			
4:	0	0	0	-1.6054e-05		
5:	0	0	0	0	0	
6:	+5.3647e-03	-2.3688e-05	0	0	0	+3.8585e-04

Comparison between COSY & LISE calculations for electric dipoles

"Cylindrical" type; Radius = 4 m; Angle = 20 deg

LISE

```
Block:  "ElecDipole"     Matrices:  "LOCAL"
                                                       transport format [cm-mrad]

                      * TRANSFORM 1 *

 1 [X]:     +8.8064e-01  +3.3510e-02   0            0            0            +1.1936e-01
 2 [T]:     -6.6995e+00  +8.8064e-01   0            0            0            +6.6995e+00
 3 [Y]:      0            0            +1.0000e+00  +3.4910e-02  0             0
 4 [F]:      0            0            0            +1.0000e+00  0             0
 5 [L]:     -6.6995e-01  -1.1940e-02   0            0            +1.0000e+00  -2.8000e-02
 6 [D]:      0            0            0            0            0            +1.0000e+00

---------------------------------------------------------------------------------------

                      * TRANSFORM 2 *

 1    1:    -2.8189e-03
 1    2:    +5.7678e-04  +5.1381e-06
 1    3:     0            0            0
 1    4:     0            0            0            -5.9697e-06
 1    5:     0            0            0            0            0
 1    6:    +5.6350e-03  +9.3310e-05   0            0            0            -1.6237e-03
---------------------------------------------------------------------------------------
 2    1:    -8.9888e-02
 2    2:    -4.3966e-03  -5.3350e-05
 2    3:     0            0            0
 2    4:     0            0            0            -3.3506e-04
 2    5:     0            0            0            0            0
 2    6:    +1.5725e-01  +4.3938e-03   0            0            0            -1.2329e-01
---------------------------------------------------------------------------------------
 3    1:     0
 3    2:     0            0
 3    3:     0            0            0
 3    4:    +6.7013e-04  +1.1939e-05   0            0
 3    5:     0            0            0            0            0
 3    6:     0            0            0            +2.8004e-05  0             0
---------------------------------------------------------------------------------------
 4    1:     0
 4    2:     0            0
 4    3:     0            0            0
 4    4:    -1.1936e-03  +3.3506e-04   0            0
 4    5:     0            0            0            0            0
 4    6:     0            0            0            +1.1936e-03  0             0
---------------------------------------------------------------------------------------
 5    1:     0
 5    2:     0            0
 5    3:     0            0            0
 5    4:     0            0            0            0
 5    5:     0            0            0            0            0
 5    6:     0            0            0            0            0             0
```

COSY

```
:  "ElecDipole"     Matrices:  "LOCAL"
                                                       transport format [cm-mrad]

                      * TRANSFORM 1 *

X]:     +8.8073e-01  +3.3510e-02   0            0            0            +1.1927e-01
T]:     -6.6943e+00  +8.8073e-01   0            0            0            +6.6943e+00
Y]:      0            0            +1.0000e+00  +3.4910e-02  0             0
F]:      0            0            0            +1.0000e+00  0             0
L]:     -6.6943e-01  -1.1930e-02   0            0            +1.0000e+00  -2.7950e-02
D]:      0            0            0            0            0            +1.0000e+00

---------------------------------------------------------------------------------------

                      * TRANSFORM 2 *

1:      -2.8145e-03
2:      +5.7693e-04  +5.1394e-06
3:       0            0            0
4:       0            0            0            -5.9698e-06
5:       0            0            0            0            0
6:      +5.6290e-03  +9.3219e-05   0            0            0            -1.6231e-03
---------------------------------------------------------------------------------------
1:      -3.0744e-02
2:      -1.0955e-03  -3.4837e-04
3:       0            0            0
4:       0            0            0            -3.3507e-04
5:       0            0            0            0            0
6:      +1.9537e-01  +1.0955e-03   0            0            0            -9.7759e-02
---------------------------------------------------------------------------------------
1:       0
2:       0            0
3:       0            0            0
4:      +6.7015e-04  +1.1939e-05   0            0
5:       0            0            0            0            0
6:       0            0            0            +2.7982e-05  0             0
---------------------------------------------------------------------------------------
1:       0
2:       0            0
3:       0            0            0
4:       0            0            0            0
5:       0            0            0            0            0
6:       0            0            0            0            0             0
---------------------------------------------------------------------------------------
1:      -6.0224e-03
2:      -3.3386e-04  -2.0081e-05
3:       0            0            0
4:       0            0            0            -1.6054e-05
5:       0            0            0            0            0
6:      +5.3647e-03  -2.3688e-05   0            0            0            +3.8585e-04
---------------------------------------------------------------------------------------
```

Comparison between COSY & LISE calculations for electric dipoles

NSCL | MICHIGAN STATE UNIVERSITY | LISE++

"Spherical" type; Radius = 4 m; Angle = 45 deg

LISE

```
Block: "ElecDipole"    Matrices: "LOCAL"
                                                          transport format [cm-mrad]

                       * TRANSFORM 1 *

 1 [X]:    +7.0717e-01  +2.8285e-01  0            0            0            +2.3429e+00
 2 [T]:    -1.7674e+00  +7.0717e-01  0            0            0            +1.4141e+01
 3 [Y]:     0            0           +7.0711e-01  +2.8284e-01  0             0
 4 [F]:     0            0           -1.7678e+00  +7.0711e-01  0             0
 5 [L]:    -1.4141e+00  -2.3429e-01  0            0            +1.0000e+00  -1.2524e+00
 6 [D]:     0            0           0            0            0            +1.0000e+00
-------------------------------------------------------------------------------------------

                       * TRANSFORM 2 *

 1   1:    -1.2502e-03
 1   2:    +1.0000e-03  +8.2843e-05
 1   3:     0            0           +2.5889e-04
 1   4:     0            0           +2.0711e-04  -1.0000e-04
 1   5:     0            0           0            0            0
 1   6:    +1.9997e-02  +3.3133e-03  0            0            0            -2.1418e-02
-------------------------------------------------------------------------------------------
 2   1:    -5.0031e-02
 2   2:    -7.0730e-03  -8.2863e-04
 2   3:     0            0           +9.1533e-04
 2   4:     0            0           +1.7678e-03  -5.0001e-04
 2   5:     0            0           0            0            0
 2   6:    +1.9990e-01  +5.6557e-02  0            0            0            -1.9997e-01
-------------------------------------------------------------------------------------------
 3   1:     0
 3   2:     0            0
 3   3:    -5.1780e-04  -2.0711e-04  0
 3   4:    +1.2071e-03  +2.0000e-04  0            0
 3   5:     0            0           0            0            0
 3   6:     0            0           +4.1417e-03  +1.6567e-03  0             0
-------------------------------------------------------------------------------------------
 4   1:     0
 4   2:     0            0
 4   3:    +2.0708e-02  -8.2846e-03  0
 4   4:    -4.9995e-03  +2.0001e-03  0            0
 4   5:     0            0           0            0            0
 4   6:     0            0           +2.4997e-02  +9.9990e-03  0             0
-------------------------------------------------------------------------------------------
 5   1:     0
 5   2:     0            0
 5   3:     0            0           0
 5   4:     0            0           0
 5   5:     0            0           0
 5   6:     0            0           0
-------------------------------------------
```

COSY

```
ck: "ElecDipole"    Matrices: "LOCAL"
                                                          transport format [cm-mrad]

                       * TRANSFORM 1 *

[X]:    +7.0717e-01  +2.8285e-01  0            0            0            +2.3429e+00
[T]:    -1.7674e+00  +7.0717e-01  0            0            0            +1.4141e+01
[Y]:     0            0           +7.0711e-01  +2.8284e-01  0             0
[F]:     0            0           -1.7678e+00  +7.0711e-01  0             0
[L]:    -1.4141e+00  -2.3429e-01  0            0            +1.0000e+00  -1.2524e+00
[D]:     0            0           0            0            0            +1.0000e+00
-------------------------------------------------------------------------------------------

                       * TRANSFORM 2 *

 1:     -1.2498e-03
 2:     +1.0001e-03  +8.2851e-05
 3:      0            0           +2.5896e-04
 4:      0            0           +2.0712e-04  -1.0000e-04
 5:      0            0           0            0            0
 6:     +1.9998e-02  +3.3133e-03  0            0            0            -2.1421e-02
-------------------------------------------------------------------------------------------
 1:      0
 2:      0           -7.0712e-04
 3:      0            0           +9.1571e-04
 4:      0            0           +1.7679e-03  -5.0000e-04
 5:      0            0           0            0            0
 6:     +7.0698e-02  -1.1922e-06  0            0            0            -2.1212e-01
-------------------------------------------------------------------------------------------
 1:      0
 2:      0            0
 3:     -5.1766e-04  -2.0709e-04  0
 4:     +1.2071e-03  +2.0001e-04  0            0
 5:      0            0           0            0            0
 6:      0            0           +4.1417e-03  +1.6567e-03  0             0
-------------------------------------------------------------------------------------------
 1:      0
 2:      0            0
 3:     +4.4203e-03  +7.3237e-04  0
 4:     -7.3210e-04  +3.0634e-08  0            0
 5:      0            0           0            0            0
 6:      0            0           +3.5352e-02  +5.8574e-03  0             0
-------------------------------------------------------------------------------------------
 1:     -1.8747e-03
 2:     -1.4999e-03  -2.6567e-04
 3:      0            0           -1.1426e-03
 4:      0            0           -8.5730e-05  -1.0000e-04
 5:      0            0           0            0            0
 6:     +1.7175e-03  -2.0584e-03  0            0            0            +1.2124e-02
-------------------------------------------------------------------------------------------
```

Using 2nd order electrostatic dipoles in EMMA @ TRIUMF

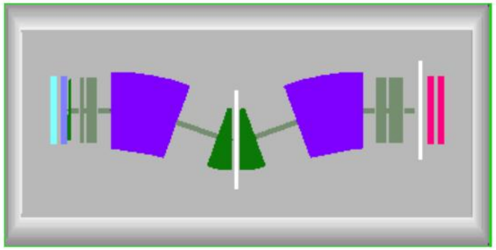
MICHIGAN STATE UNIVERSITY
LISE++

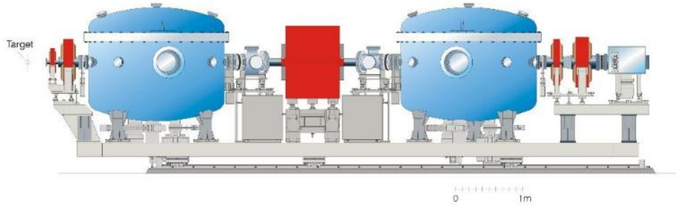
http://lise.nscl.msu.edu/9_10/EMMA.pdf

EMMA (ElectroMagnetic Mass Analyzer) @ TRIUMF

Version 9.10.207 from 11/17/2015

Link: Separator "EMMA" @ TRIUMF





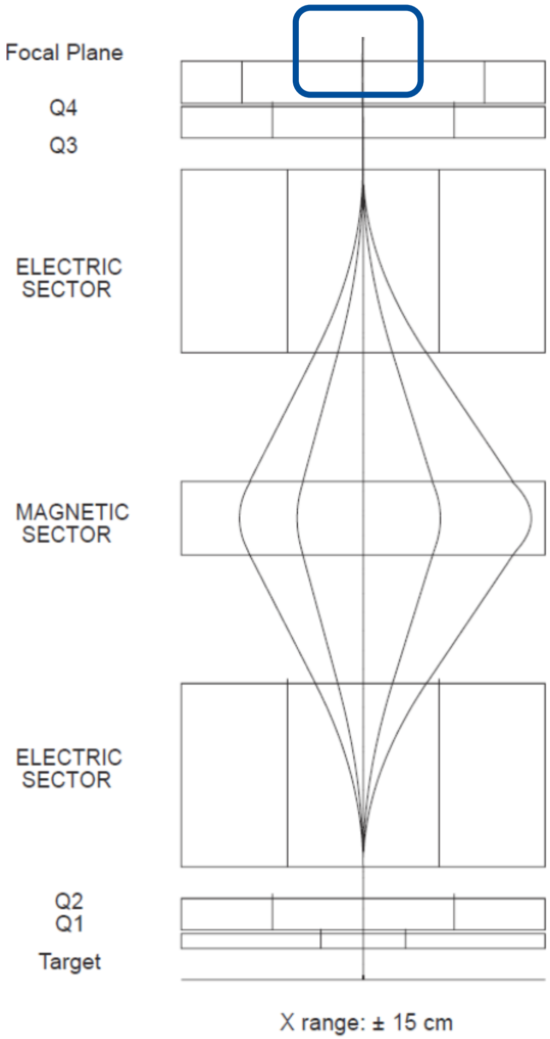
The new version with 2nd order electrostatic dipoles :

http://lise.nscl.msu.edu/9_10/ED/EMMA_2016.lpp

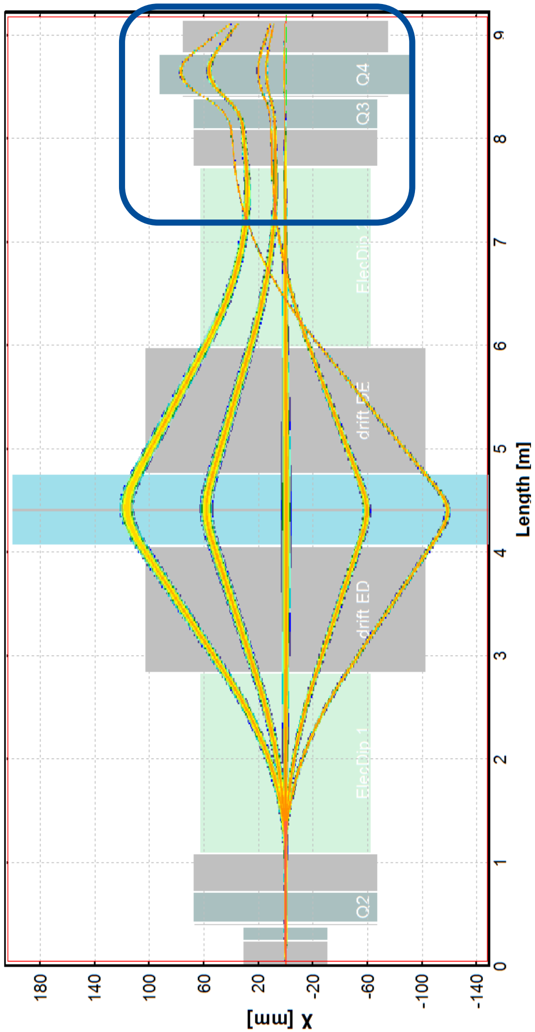
Or in the LISE++ package "files\examples\TRIUMF\EMMA_2016.lpp"

Using 2nd order electrostatic dipoles in EMMA @ TRIUMF

NIM A544 (2005) 565

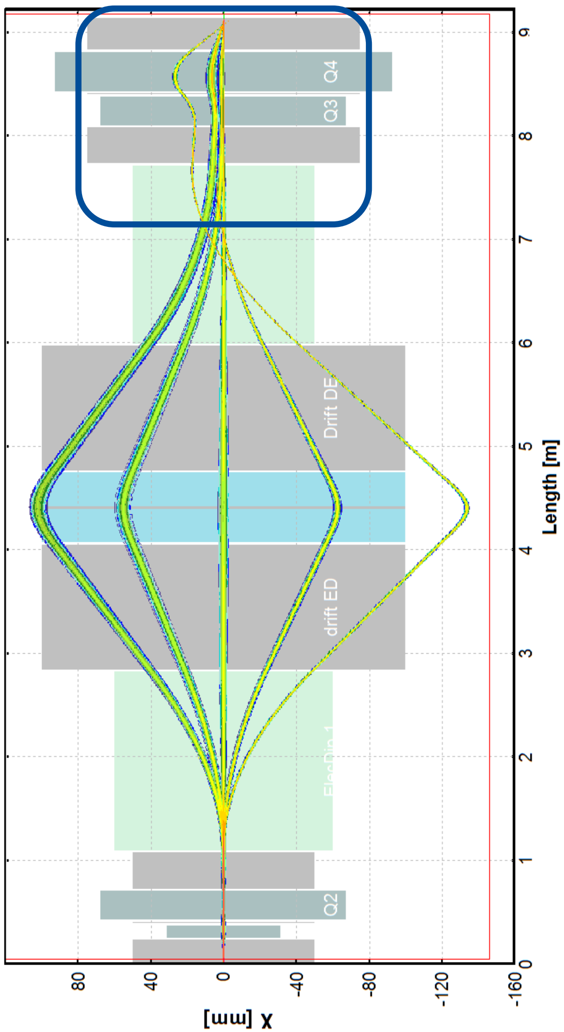


LISE++ v.9.10.207



2nd order

LISE++ v.9.10.296



2nd order

NIM A544 (2005) 565

LISE++ v.9.10.296

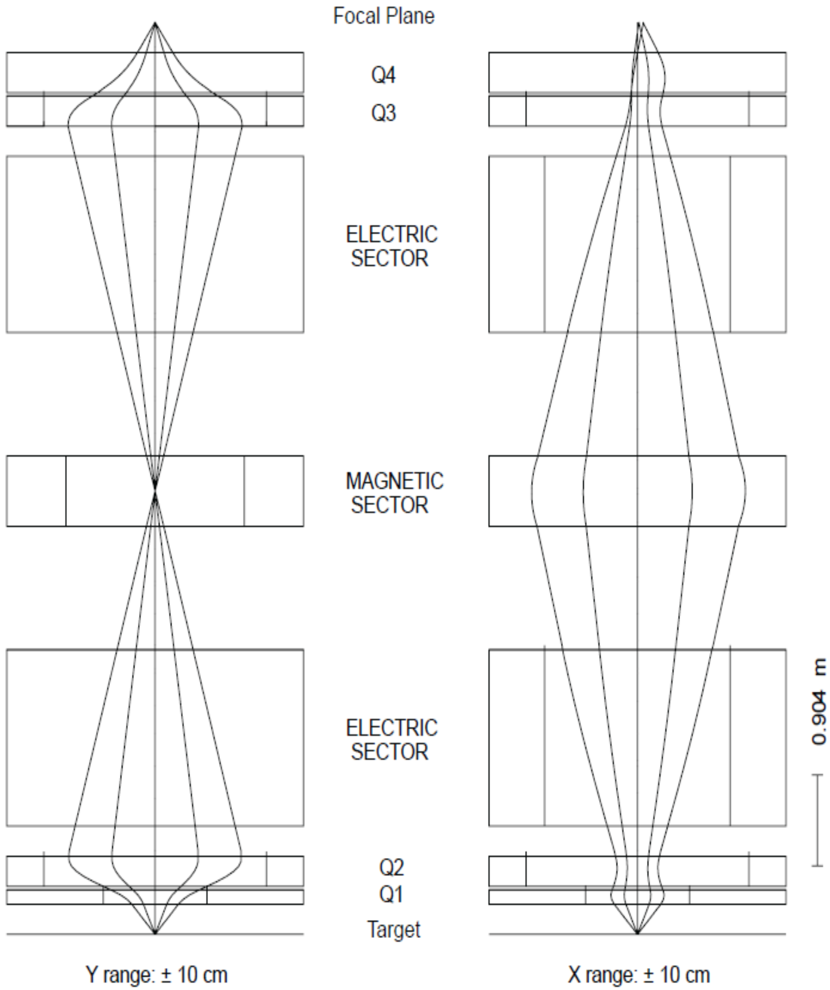
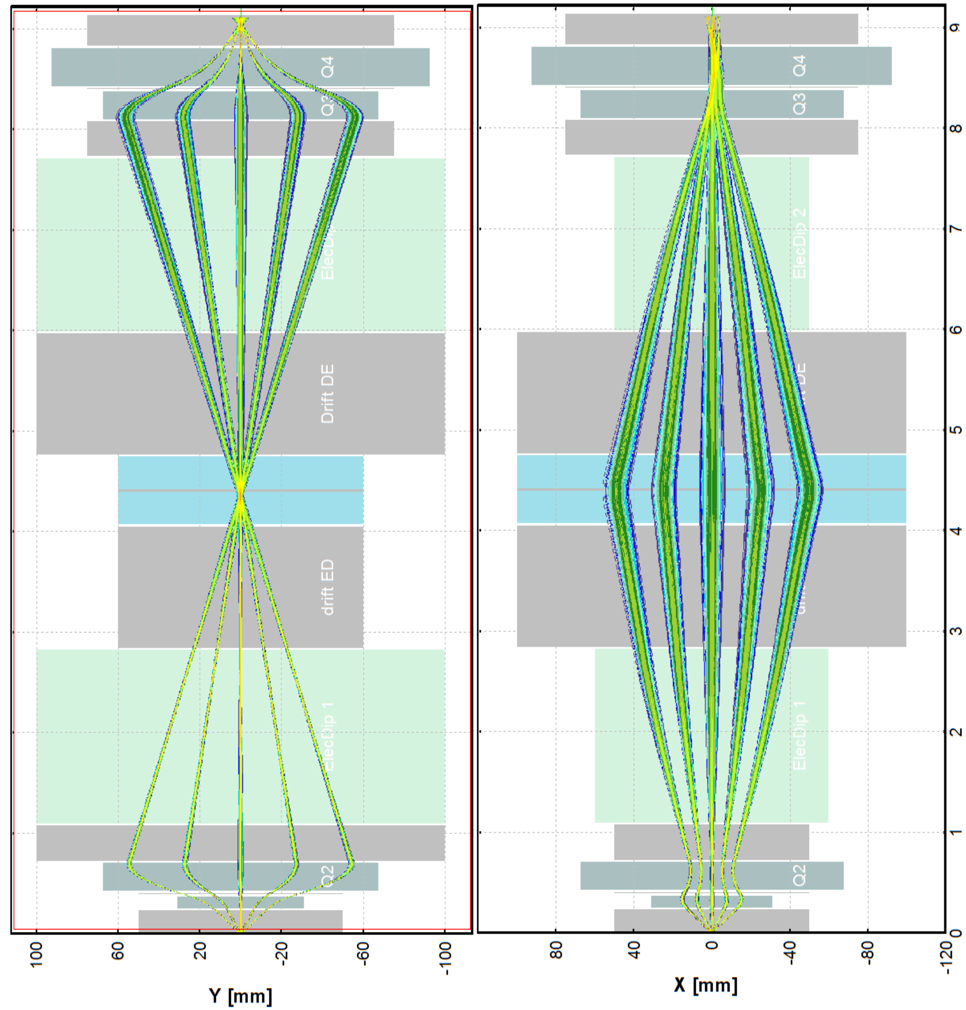


Fig. 4. Calculated spatial focus of EMMA, showing rays corresponding to a single mass emitted from the target with angles of 0, ±1.5°, and ±3° in the vertical and horizontal directions. The dominant geometric aberration in the dispersive direction, proportional to the square of the horizontal angle, is evident in the horizontal extent of the final focus.



2nd order **2nd order**

Using 2nd order electrostatic dipoles in EMMA @ TRIUMF

NIM A544 (2005) 565

LISE++ v.9.10.296

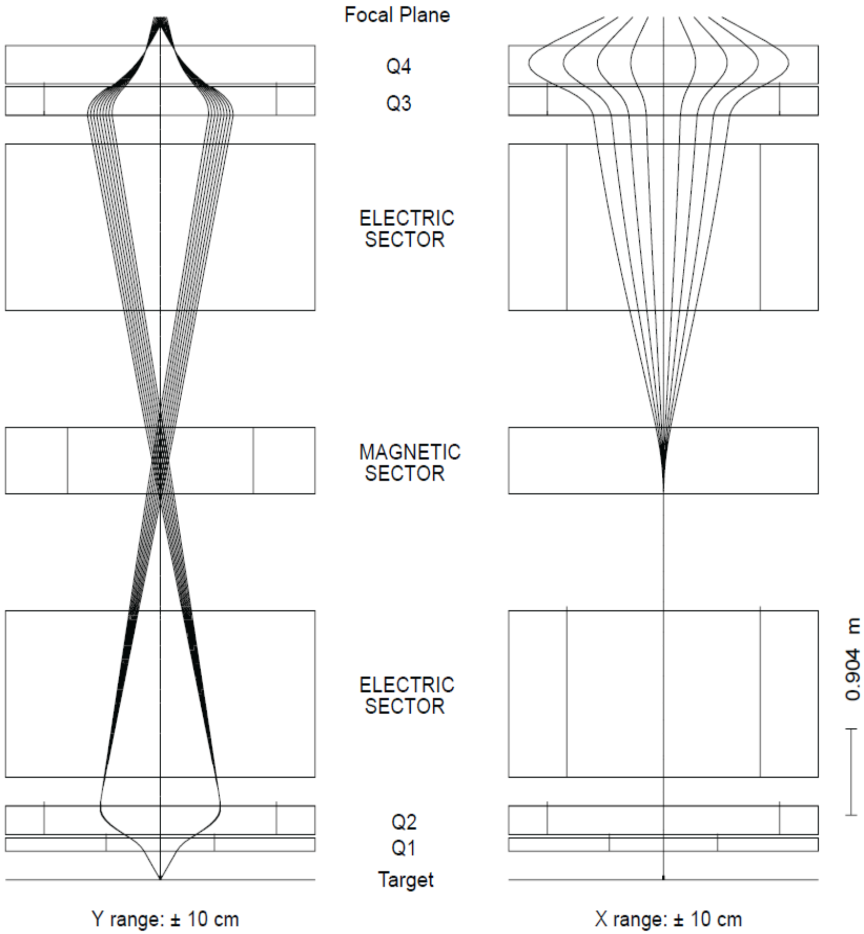
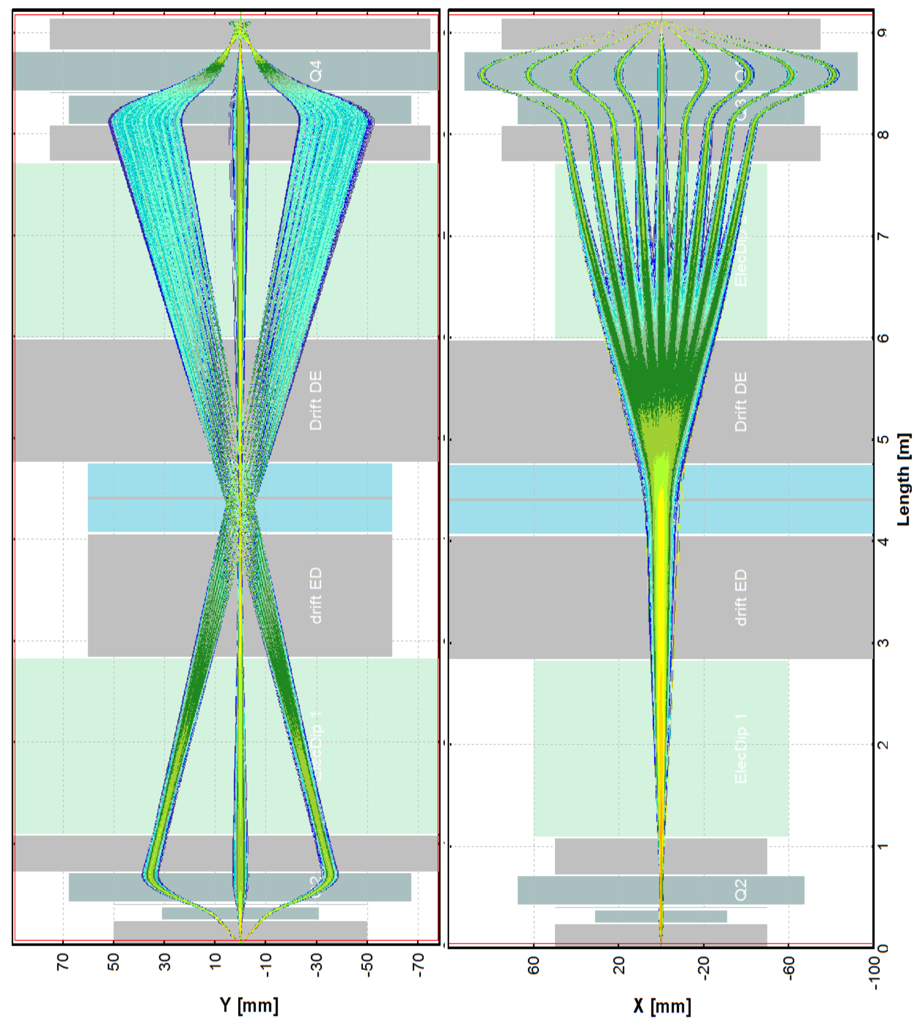


Fig. 2. Calculated mass focus of EMMA, showing rays corresponding to 9 adjacent masses emitted from the target with vertical angles of −2°, 0°, and 2°. At the focal plane, the 9 masses are seen to be dispersed horizontally and focussed vertically. Angular focussing in the horizontal direction is shown in Fig. 4.



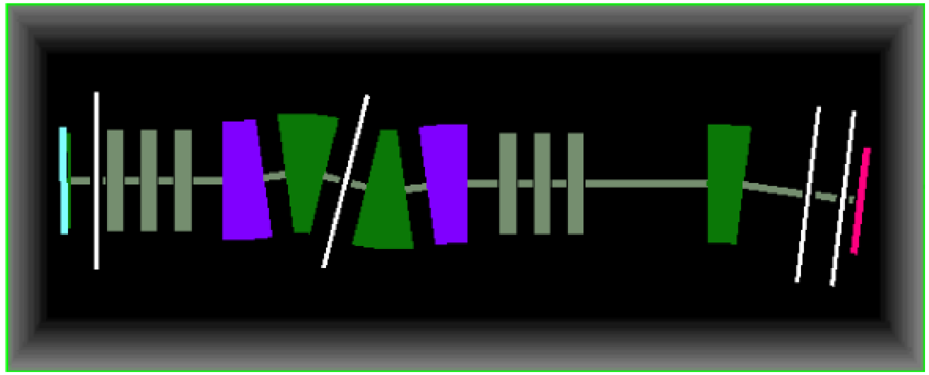
2nd order **2nd order**

with σ(X)=0.02mm & σ(Y')=1mrad

Using 2nd order electrostatic dipoles in SHELS @ FLNR/JINR

v.9.8.166
from 11/23/14

http://lise.nscl.msu.edu/9_8/SHELS/SHELSinLISE.pdf



Preparation to the experiment

Transmission : Analytical

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

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

9.098 / 17.15 * 100%

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 %

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
Reaction		FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes
Ion Production Rate	(pps)	6.1e-3	1.99e-2	4.92e-2	1.01e-1	1.67e-1	2.34e-1	2.43e-1	1.96e-1	1.1e-1	4.77e-2	1.44e-2	2.71e-3
Total ion transmission	(%)	0.229	0.745	1.847	3.776	6.264	8.783	9.098	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
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

How 2nd order optics calculations are important for transmission value in the case of the SHELS separator ?

The new version with 2nd order electrostatic dipoles :

http://lise.nscl.msu.edu/9_10/ED/SHELS_2016_o2.lpp

Or in the LISE++ package "files\examples\Dubna\SHELS_2016_o2.lpp"

Overall transmission = transmission through a separator of given isotope created in a target

1st order; Analytical solution

statistics: 255Lr

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

$^{255}Lr^{All}$ overall transmission 52.9%

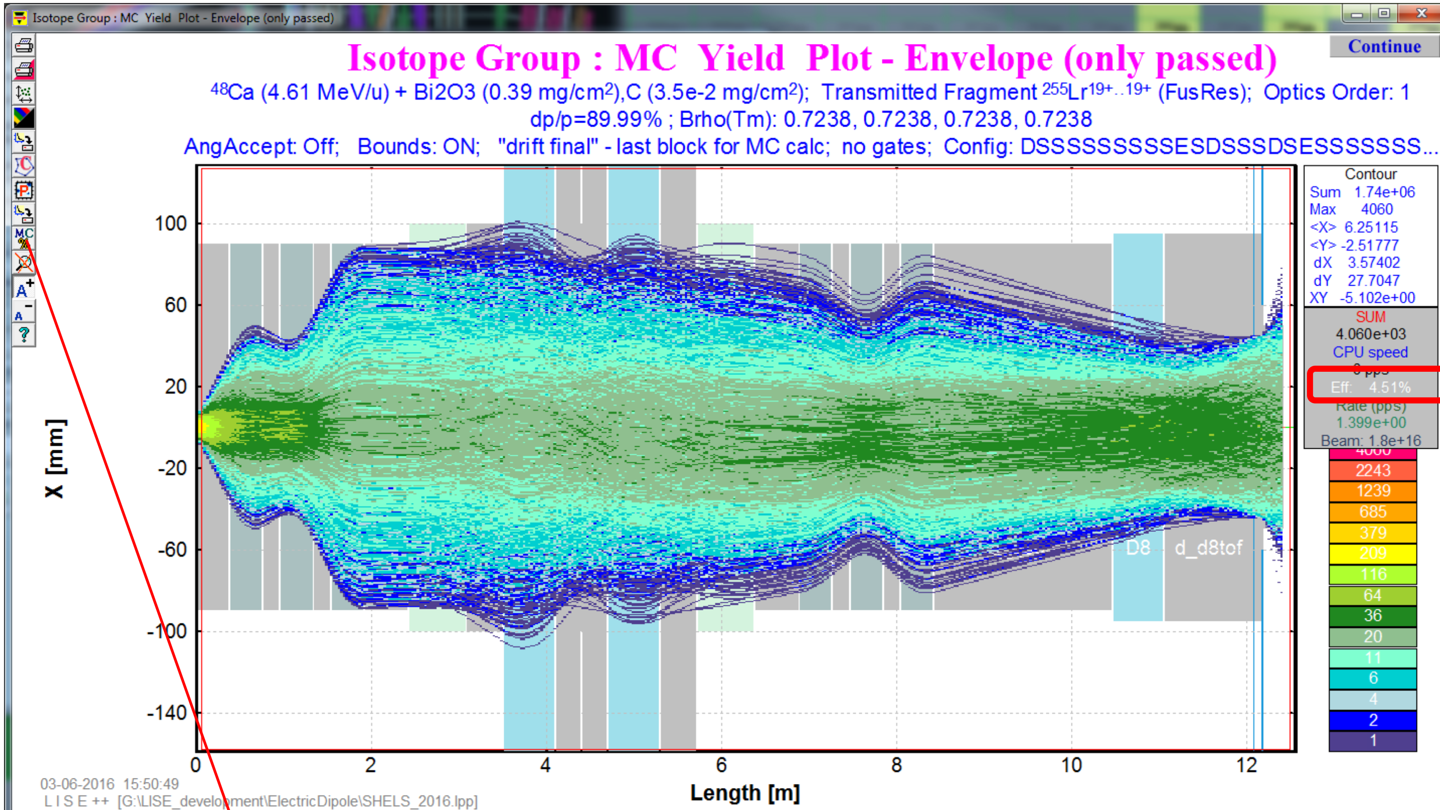
$^{255}Lr^{19+}$ transmission

10.325% / 0.171 = **60.4%**

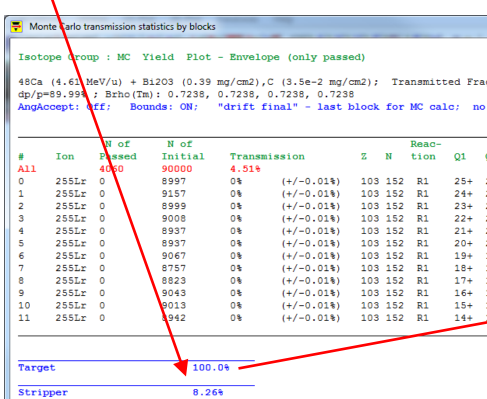
All reactions total isotope rate 1.37e+0 pps
and Overall isotope transmission 52.914 %

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
Reaction		FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes	FusRes
Ion Production Rate	(pps)	7.5e-3	2.33e-2	5.97e-2	1.24e-1	2.07e-1	2.64e-1	2.67e-1	2.2e-1	1.29e-1	5.39e-2	1.26e-2	9.83e-4
Total ion transmission	(%)	0.29	0.903	2.311	4.786	7.995	10.208	10.325	8.509	4.975	2.086	0.488	0.038
Total: this reaction	(pps)	1.37e+0	1.37e+0	1.37e+0	1.37e+0	1.37e+0	1.37e+0	1.37e+0	1.37e+0	1.37e+0	1.37e+0	1.37e+0	1.37e+0
X-Section in target	(mb)	1.62e-4	1.62e-4	1.62e-4	1.62e-4	1.62e-4	1.62e-4	1.62e-4	1.62e-4	1.62e-4	1.62e-4	1.62e-4	1.62e-4
Target	(%)	100	99.57	100	100	100	100	100	100	100	100	99.57	100
Unreacted in material	(%)	100	100	100	100	100	100	100	100	100	100	100	100
Unstopped in material	(%)	100	99.57	100	100	100	100	100	100	100	100	99.57	100
Stripper	(%)	0.922	2.41	5.22	9.34	13.81	16.89	17.08	14.28	9.87	5.64	2.66	1.04
Unreacted in material	(%)	100	100	100	100	100	100	100	100	100	100	100	100
Q (Charge) ratio	(%)	0.922	2.41	5.22	9.34	13.82	16.89	17.08	14.28	9.87	5.64	2.66	1.04
Unstopped in material	(%)	100	100	100	100	100	100	100	100	100	100	100	100

1st order; Monte Carlo solution; Overall transmission



^{255}Lr transmission
4.51%
Including charge state contribution



Monte Carlo transmission statistics by blocks

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

48Ca (4.61 MeV/u) + Bi2O3 (0.39 mg/cm2),C (3.5e-2 mg/cm2); Transmitted Frag
dp/p=89.99% ; Brho(Tm): 0.7238, 0.7238, 0.7238, 0.7238
AngAccept: Off; Bounds: ON; "drift final" - last block for MC calc; no

#	Ion	N of Passed	N of Initial	Transmission		Z	N	Reac-tion	Q1	Q
All		4060	90000	4.51%						
0	255Lr	0	8997	0%	(+/-0.01%)	103	152	R1	25+	2
1	255Lr	0	9157	0%	(+/-0.01%)	103	152	R1	24+	2
2	255Lr	0	8999	0%	(+/-0.01%)	103	152	R1	23+	2
3	255Lr	0	9008	0%	(+/-0.01%)	103	152	R1	22+	2
4	255Lr	0	8937	0%	(+/-0.01%)	103	152	R1	21+	2
5	255Lr	0	8937	0%	(+/-0.01%)	103	152	R1	20+	2
6	255Lr	0	9067	0%	(+/-0.01%)	103	152	R1	19+	1
7	255Lr	0	8757	0%	(+/-0.01%)	103	152	R1	18+	1
8	255Lr	0	8823	0%	(+/-0.01%)	103	152	R1	17+	1
9	255Lr	0	9043	0%	(+/-0.01%)	103	152	R1	16+	1
10	255Lr	0	9013	0%	(+/-0.01%)	103	152	R1	15+	1
11	255Lr	0	8942	0%	(+/-0.01%)	103	152	R1	14+	1

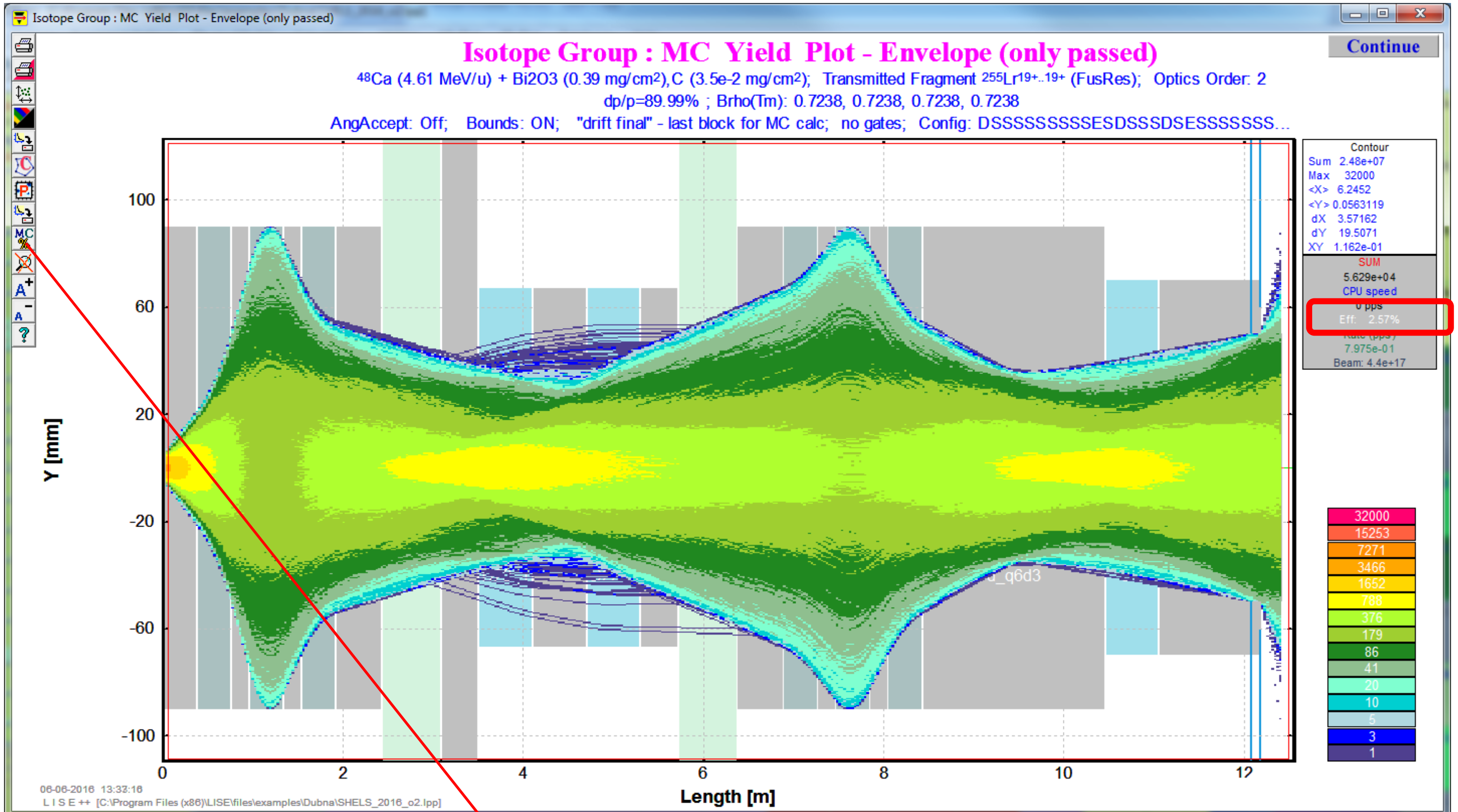
Target 100.0%

Stripper 8.26%
Q-state 8.26%

^{255}Lr transmission
Q-state = 8.26%

$^{255}Lr^{All}$ overall transmission 54.6%

2nd order; Monte Carlo solution; Overall transmission

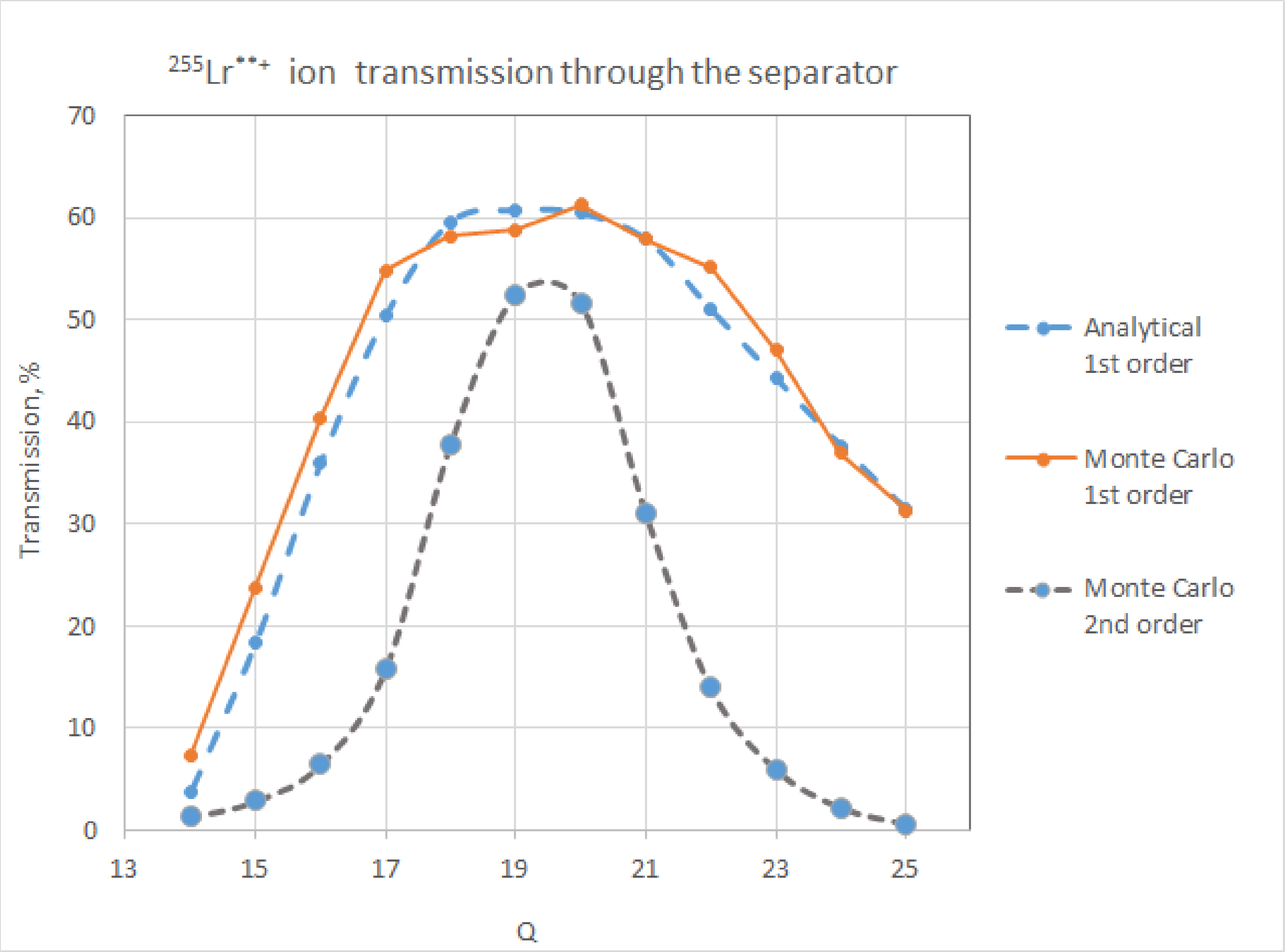


255Lr transmission
2.57%
Including charge state contribution

255LrAll overall transmission 31.2%

255Lr transmission
Q-state = 8.24%

^{255}Lr ion transmission

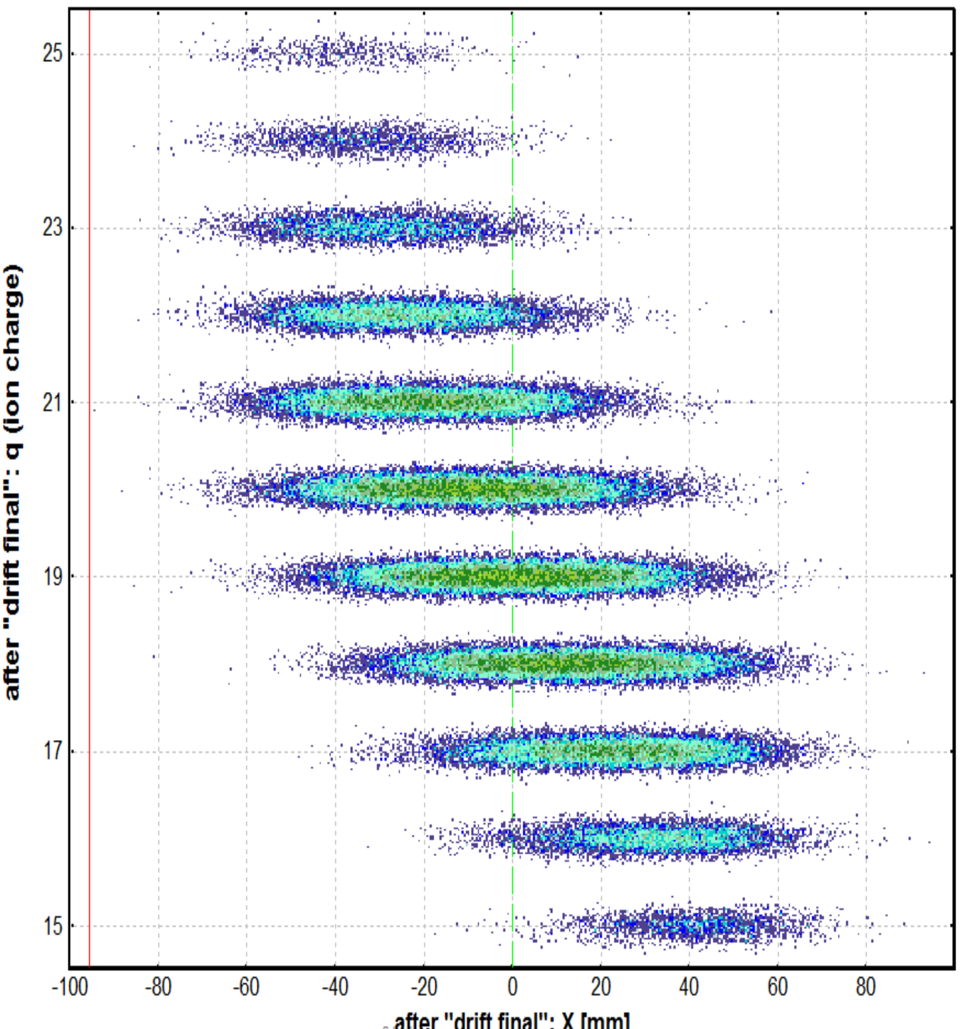


^{255}Lr ion transmission

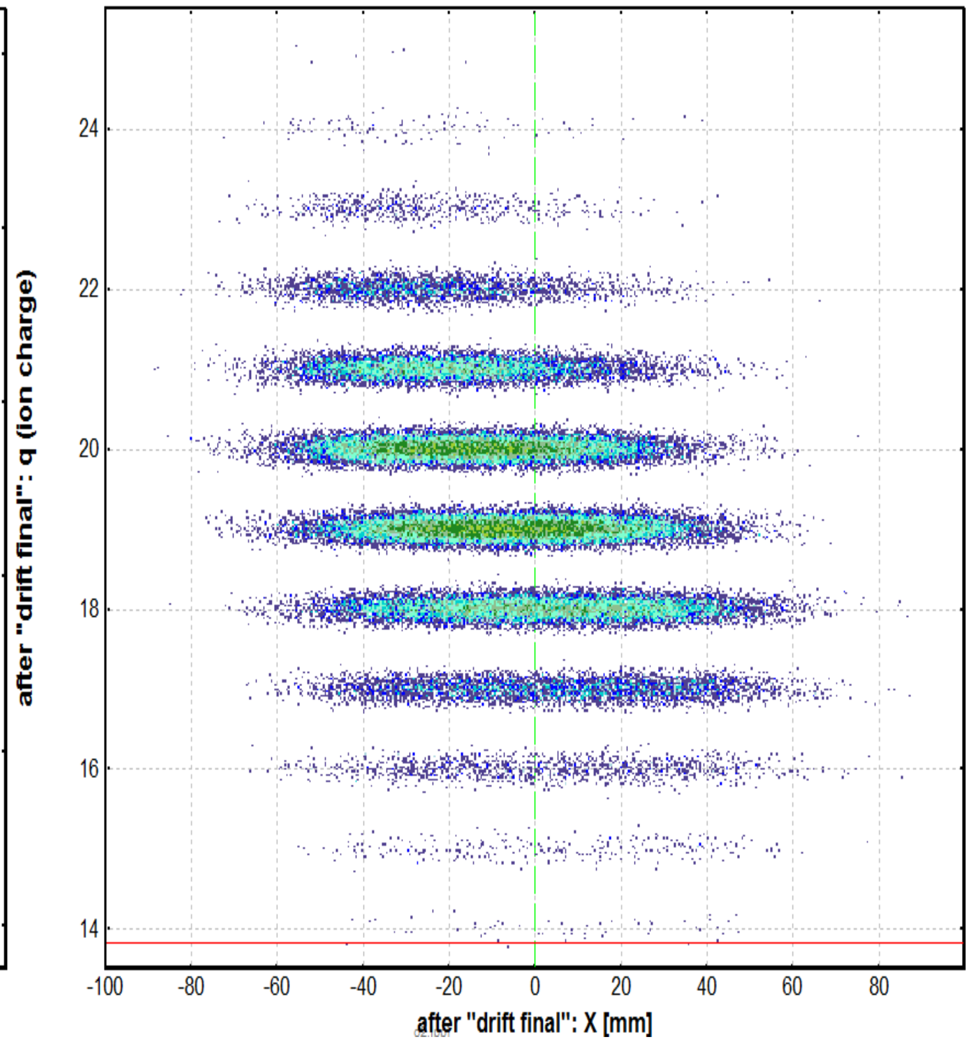
	Transmission including charge state production				Q-Production			Pure transmission through the separator		
Q	Analytical 1st order	Monte Carlo 1st order	Monte Carlo 2nd order		q-state Analyt.	q-state Monte Carlo		Analytical 1st order	Monte Carlo 1st order	Monte Carlo 2nd order
	%	%	%		%	%		%	%	%
25	0.29	0.194	0.00385		0.922	0.62		31.45	31.29	0.62
24	0.91	0.66	0.04		2.41	1.79		37.63	36.87	2.23
23	2.31	1.8	0.228		5.22	3.83		44.27	47.00	5.95
22	4.77	4.28	1.08		9.34	7.76		51.03	55.15	13.92
21	8.00	7.1	3.8		13.82	12.27		57.88	57.86	30.97
20	10.21	9.53	8.02		16.89	15.56		60.44	61.25	51.54
19	10.37	10.4	9.26		17.08	17.69		60.72	58.79	52.35
18	8.51	9.08	5.9		14.28	15.61		59.59	58.17	37.80
17	4.97	6.31	1.82		9.87	11.51		50.40	54.82	15.81
16	2.03	2.99	0.476		5.64	7.4		35.96	40.41	6.43
15	0.49	0.898	0.108		2.66	3.79		18.35	23.69	2.85
14	0.04	0.118	0.0206		1.04	1.63		3.65	7.24	1.26
Overall isotope production								**52.9**	**54.6**	**31.2**
(how many passed through the separator to how many produced in the target)										

^{255}Lr ion distribution @ final plane

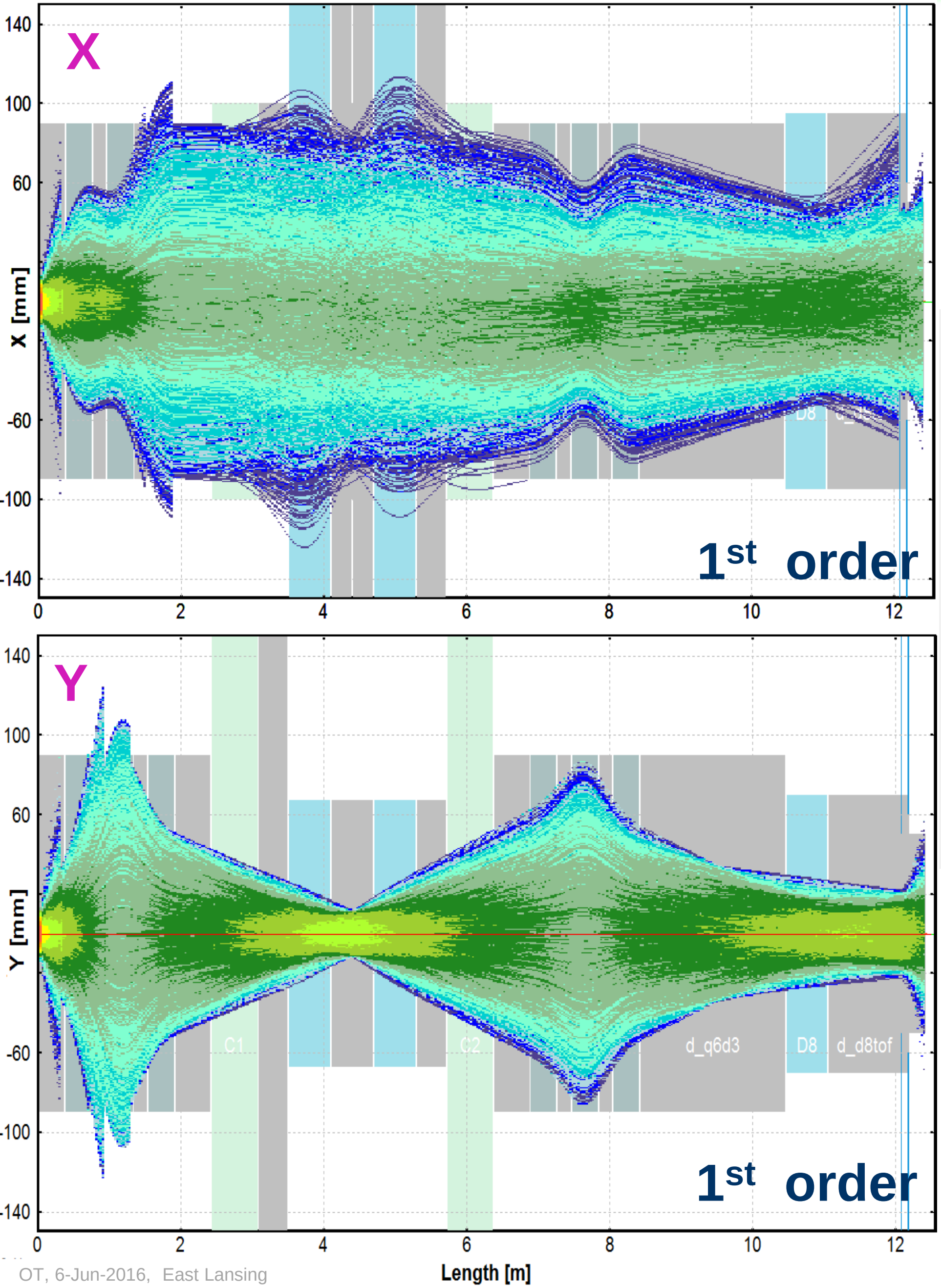
1st order

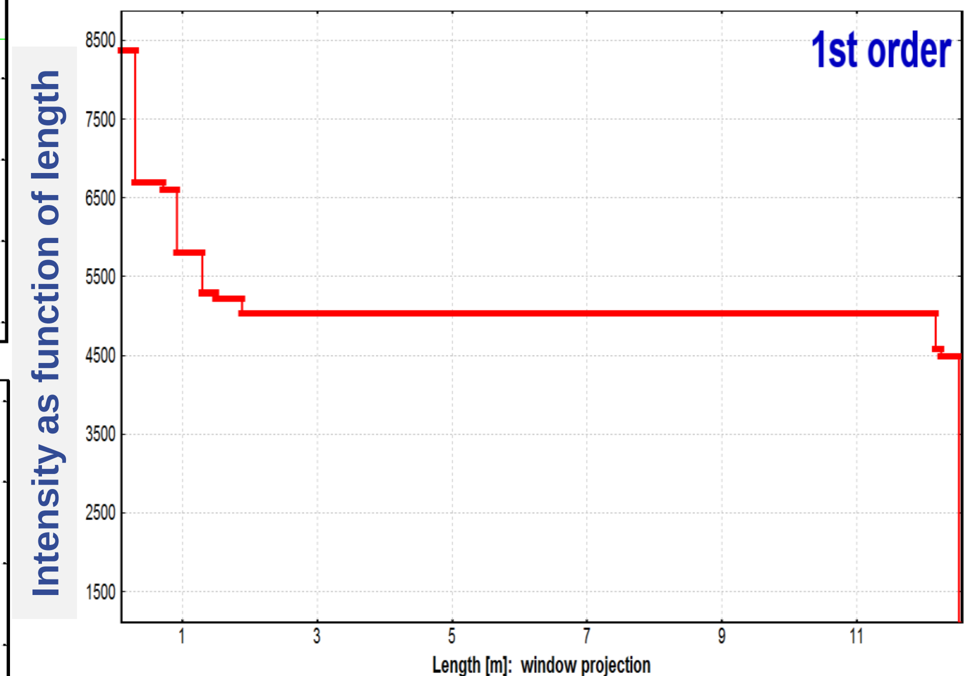


2nd order

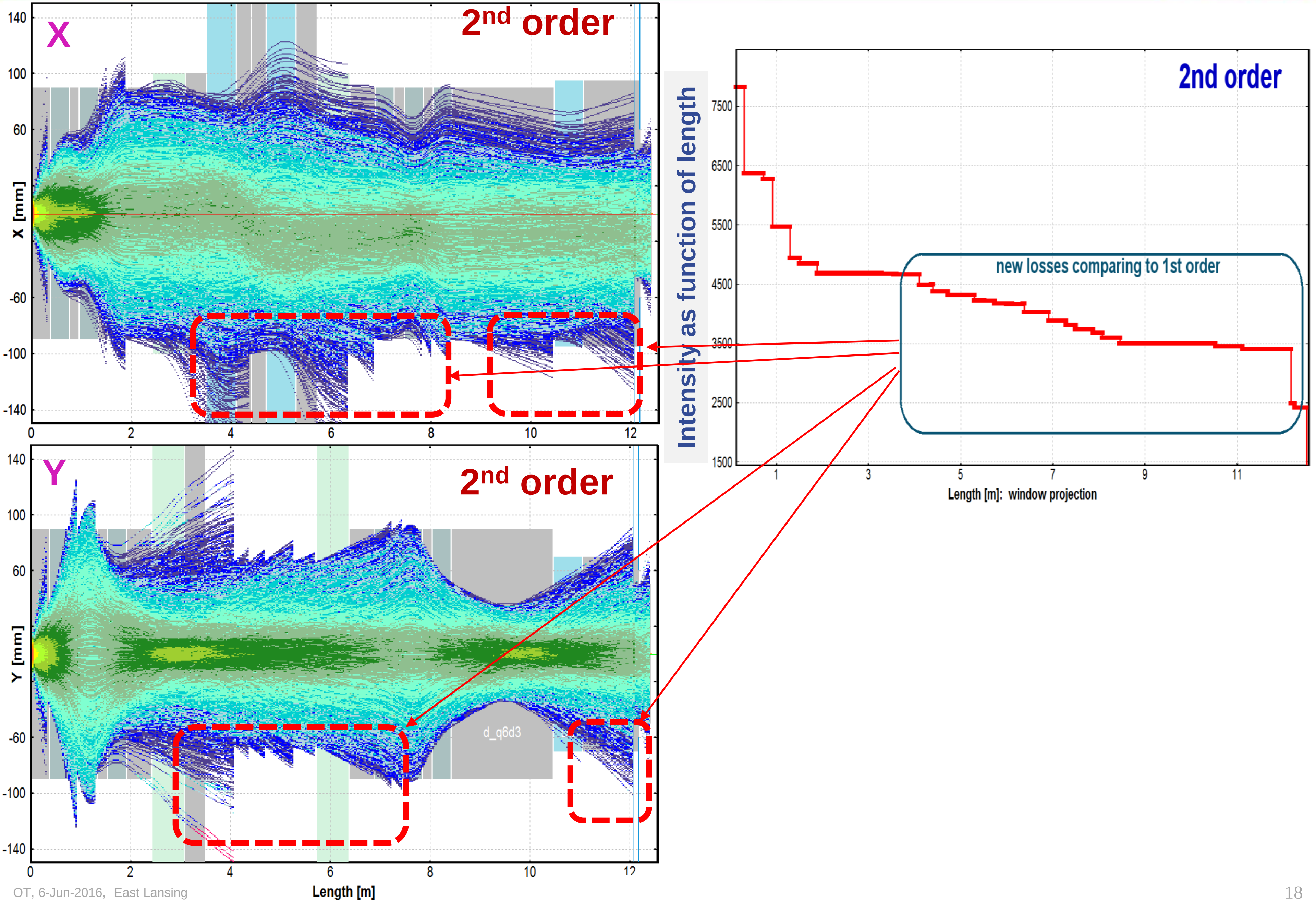


^{255}Lr ions envelopes (option "show all trajectories") : 1st order





^{255}Lr ions envelopes (option “show all trajectories”) : 2^{nd} order



Outlook

To find out why the difference between H.Wollnik (used in $LISE^{++}$) and COSY calculations for θ/** & φ/** elements