

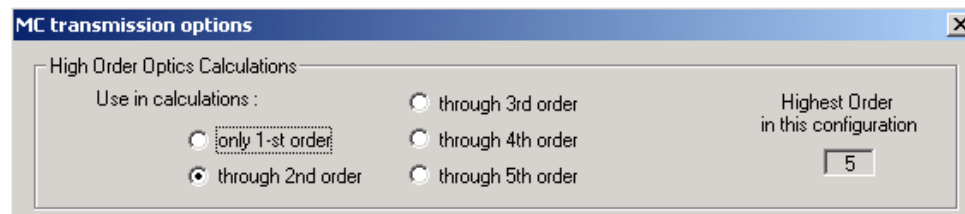
The code operates under MS Windows environment and provides a highly user-friendly interface.  
It can be freely downloaded from the following internet addresses:

<http://www.nsci.msu.edu/lise>

See “a1900\_FifthOrder.lpp” in the Installation package

## version 8.3.158

- up to 5<sup>th</sup> order calculations in MC mode
- for this Friday this presentation was planned 2<sup>nd</sup>, but...
- The code can be used for transmission calculations with high order aberrations, deduce angular acceptances, check other codes (as MOTER), user-friendly interface for introduction in high-order optics
- MOCADI A1900 file for LISE<sup>++</sup>, as well as translator from MOCADI to LISE<sup>++</sup>
- The Optics dialog should be commissioned, as well Local <-> Global transformation.
- New utility for MC mode (Envelope plot to see transmission loss)



- LISE++ uses for transmission calculations **only** LOCAL matrices for both (Distribution and MC) methods
- Global matrices (1<sup>st</sup> order) were more convenient to import from TRANSPORT
- Now with import of the **LOCAL** matrices up to 5<sup>th</sup> order.
- Second order matrices can be entered manually using matrix dialog, for higher orders import of COSY map file, or editing LISE++ file.

## COSY file

```

PRIMARY_BEAM ;

CR ; INITIALIZE_RAYS ;   SR 0 0      0 0      0 0      0 0  1 ;
BP ;

UM ;
FR 0 ;
DL S1L1 ;
  M5 T1LA  Z017TA*SCLB 0*SCLB 0*SCLB 0 0   0.133 ;
DL S1L2 ;
  M5 T1LB  Z019TB*SCLB 0*SCLB 0*SCLB 0 0   0.133 ;
DL S1L3 ;
  M5 T1LC  Z021TC*SCLB Z021SX*SCLB Z021MC*SCLB 0 0   0.15 ;
DL S1L4 ;

  DI 3.094  45.0  0.045   0 0  0 0 ;

DL S1L5 ;
  M5 T2LA  Z031TA*SCLB Z031SX*SCLB Z031MC*SCLB 0 0   0.15 ;
DL S1L6 ;
  M5 T2LB  Z033TB*SCLB Z033SX*SCLB Z033MC*SCLB 0 0   0.15 ;
DL S1L7 ;
  M5 T2LC  Z035TC*SCLB Z035SX*SCLB Z035MC*SCLB 0 0   0.15 ;
DL S1L8 ;

PM_LISE 'IMG1_COSY.TXT' ;

UM ;
DL S2L1 ;
  M5 T3LA  Z039TA*SCLB Z039SX*SCLB Z039MC*SCLB 0 0   0.15 ;
DL S2L2 ;
  M5 T3LB  Z041TB*SCLB Z041SX*SCLB Z041MC*SCLB 0 0   0.15 ;
DL S2L3 ;
  M5 T3LC  Z043TC*SCLB Z043SX*SCLB Z043MC*SCLB 0 0   0.15 ;
DL S2L4 ;

  CB ; DI 3.094  45.0  0.045   0 0  0 0 ; CB ;

DL S2L5 ;
  M5 T4LA  Z053TA*SCLB Z053SX*SCLB Z053MC*SCLB 0 0   0.15 ;
DL S2L6 ;
  M5 T4LB  Z055TB*SCLB 0*SCLB 0*SCLB 0 0   0.15 ;
DL S2L7 ;
  M5 T4LC  Z057TC*SCLB 0*SCLB 0*SCLB 0 0   0.21 ;
DL S2L8 ;

PM_LISE 'IMG2_COSY.TXT' ;

```

```

Lister - [c:\user\c\lise_pp_83\files\cosy\FifthOrder\IMG1_COSY.TXT]
File Edit Options Help
6 1
-.23036E+01 .90815E-03 .00000E+00 .00000E+00 .00000E+00 .28887E+01
.10757E+02 -.43835E+00 .00000E+00 .00000E+00 .00000E+00 -.96289E-04
.00000E+00 .00000E+00 .75082E+00 .11788E-02 .00000E+00 .00000E+00
.00000E+00 .00000E+00 .37351E+02 .13905E+01 .00000E+00 .00000E+00
.31073E+01 -.12662E+00 .00000E+00 .00000E+00 .10000E+01 -.24223E+00
.00000E+00 .00000E+00 .00000E+00 .00000E+00 .00000E+00 .10000E+01
----- MAP IN TRANSPORT UNITS, COSY FORMAT, PM
.1495016E-12 .0000000 .0000000 .0000000 .0000000 000000
-2.303570 10.75695 .0000000 .0000000 3.107285 100000
.9081494E-03 -.4383496 .0000000 .0000000 -.1266239 010000
.0000000 .0000000 .7508238 37.35126 .0000000 001000
.0000000 .0000000 .1178834E-02 1.390514 .0000000 000100
.0000000 .0000000 .0000000 .0000000 1.000000 000010
2.888651 -.9628933E-04 .0000000 .0000000 -.2422335 000001
-.2790306 -.2719936 .0000000 .0000000 -.8022218E-01 200000
.1814153E-01 .2169344E-01 .0000000 .0000000 .4590367E-02 110000
-.2924729E-03 -.3646087E-03 .0000000 .0000000 -.1233354E-03 020000
.0000000 .0000000 -.2875726 -3.395282 .0000000 101000
.0000000 .0000000 .5194432E-02 .7699961E-01 .0000000 011000
-.1531596 -1.062890 .0000000 .0000000 -.2369491 002000
.0000000 .0000000 -.1385900E-01 -.1621949 .0000000 100100
.0000000 .0000000 .2685810E-03 .3861999E-02 .0000000 010100
-.1606992E-01 -.9680975E-01 .0000000 .0000000 -.2464215E-01 001100
.3864437E-01 -.3023526 .0000000 .0000000 -.1508210E-01 100001
.8540427E-03 -.1122261E-01 .0000000 .0000000 -.2573938E-02 010001
.0000000 .0000000 .2329722E-01 -1.081405 .0000000 001001
-.4162447E-03 -.2197651E-02 .0000000 .0000000 -.7913614E-03 000200
.0000000 .0000000 -.2377957E-02 -.1631402 .0000000 000101
-.2246381E-01 .1942907 .0000000 .0000000 -.1588118E-01 000002
.2496851E-02 .6822664E-02 .0000000 .0000000 .1717573E-02 300000
-.3669691E-03 -.7664941E-03 .0000000 .0000000 -.2277991E-03 210000
.1397706E-04 .2719766E-04 .0000000 .0000000 .1044545E-04 120000
-.2248783E-06 .2572266E-06 .0000000 .0000000 .2452711E-08 030000
.0000000 .0000000 .4421901E-01 .3752077 .0000000 201000
.0000000 .0000000 -.1857340E-02 -.1583853E-01 .0000000 111000
.0000000 .0000000 .1932137E-04 .1769933E-03 .0000000 021000
.9622497E-01 .3748885 .0000000 .0000000 .2362062E-01 102000
-.2494744E-02 -.9068004E-02 .0000000 .0000000 -.6440559E-03 012000

```

- LISE++ is looking for strings ended on 6 chars (0-5) in row

- Other lines are omitted

- COSY command

PTWT UI; or PT UI;  
 TRANSPORT  
 dimensions(cm-mrad)

- if you have COSY and LISE++ (1<sup>st</sup> order) files, then only 5 minutes to create high order matrices and implement them in the LISE++ file

Added 09/15/09

```

0.000000E+00 0.000000E+00 0.37427E+02 0.13653E+01 0.000000E+00 0.000000E+00
0.31074E+01 -0.12927E+00 0.000000E+00 0.000000E+00 0.10000E+01 0.57769E+00
0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00 0.000000E+00 0.10000E+01
----- MAP IN TRANSPORT UNITS, COSY FORMAT, PM
0.2359988E-12 -0.1174798E-11 0.000000 0.000000 -0.3108624E-12 000000
-2.284592 0.000000 0.000000 0.000000 3.107380 100000
0.8986714E-03 -0.4418947 0.000000 0.000000 -0.1292682 010000
0.000000 0.000000 0.7385298 37.42714 0.000000 001000
0.000000 0.000000 0.2212702E-03 1.365255 0.000000 000100
0.000000 0.000000 0.000000 0.000000 1.000000 000010
2.925327 -0.2825546E-02 0.000000 0.000000 0.5776943 000001
-0.7919284E-02 -0.4093931E-01 0.000000 0.000000 -0.7889948E-01 200000
0.3007172E-03 0.1897271E-02 0.000000 0.000000 0.4661546E-02 110000
-0.6278116E-05 0.2484652E-04 0.000000 0.000000 -0.1264526E-02 020000

```

pay attention for COSY9 problems with output.  
complaint was sent. In process

-0.7919284E-02 -0.4093931E-01

```

----- MAP IN TRANSPORT UNITS, COSY FORMAT, PM
.1495016E-12 .0000000 .0000000 .0000000 .0000000 00000000
-2.303570 10.75695 .0000000 .0000000 3.107285 10000000
.9081494E-03 -.4383496 .0000000 .0000000 -.1266239 01000000
.0000000 .0000000 .7508238 37.35126 .0000000 00100000
.0000000 .0000000 .1178834E-02 1.390514 .0000000 00010000
.0000000 .0000000 .0000000 .0000000 1.0000000 00001000
2.888651 -.9628933E-01 .0000000 .0000000 -.2422335 00000100
120.8617 -.4027631E-02 .0000000 .0000000 .0000000 00000010
-.2790306 -.2719936 .0000000 .0000000 -.8022218E-01 20000000
.1814153E-01 .2169344E-01 .0000000 .0000000 .4590367E-02 11000000
-.2924729E-03 -.3646087E-03 .0000000 .0000000 -.1233354E-03 02000000
.0000000 .0000000 -.2875726 -3.395282 .0000000 10100000
.0000000 .0000000 .5194432E-02 .7699961E-01 .0000000 01100000
-.1531596 -1.062890 .0000000 .0000000 -.2369491 00200000
.0000000 .0000000 -.1385900E-01 -.1621949 .0000000 10010000
.0000000 .0000000 .2685810E-03 .3861999E-02 .0000000 01000000
-.1606992E-01 -.9680975E-01 .0000000 .0000000 -.2464215E-01 00110000
-.4162447E-03 -.2197651E-02 .0000000 .0000000 -.7913614E-03 00020000
.3864437E-01 -.3023526 .0000000 .0000000 -.1508210E-01 10000100
.8540427E-03 -.1122261E-01 .0000000 .0000000 -.2573938E-02 01000100
.0000000 .0000000 .2329722E-01 -1.081405 .0000000 00100100
.0000000 .0000000 -.2377957E-02 -.1631402 .0000000 00010100
5.533966 -1.756564 .0000000 .0000000 1.543158 10000010
-.1920568 -.1555533 .0000000 .0000000 -.2011607E-01 01000010
.0000000 .0000000 7.809142 65.54887 .0000000 00100001
.0000000 .0000000 .0000000 .0000000 .0000000 00010001
-.2246381E-01 .1942907 .0000000 .0000000 -.1588118E-01 00000200
5.001050 11.55260 .0000000 .0000000 .0162220 00000110

```

first SIX digits will be used

Lines with non-zero  
7-10 columns will be omitted

- LISE++ is looking for strings ended on 6-10 chars (0-5) in row

clicking NON in the case of already existing non-zero second and higher order matrices you erase high order information for this block

to input manually

**Optical matrix - D1**

$G_i = L_i * G_{i-1}$   
G - Global, L - Block (Local)

Dimension:  mm  cm

Matrices: Block (local)  Global

Second Order LOCAL matrix: Non  Exist  only for Monte Carlo transmission

Block matrix						
1. X	-2.3037	0.0092	0	0	0	28.886
2. T	1.0756	-0.4384	0	0	0	0.0001
3. Y	0	0	0.7381	0.0023	0	0
4. F	0	0	3.7303	1.3663	0	0
5. L	0	0	0	0	1	0
6. D	0	0	0	0	0	1

Units: /[mm] /[mrad] /[mm] /[mrad] /[mm] /[%]

Det = 0.99993

Global matrix

-2.3037	0.0092	0	0	0	28.886	[mm]
1.0756	-0.4384	0	0	0	0.0001	[mrad]
0	0	0.7381	0.0023	0	0	[mm]
0	0	3.7303	1.3663	0	0	[mrad]
0	0	0	0	1	0	[mm]
0	0	0	0	0	1	[%]

Units: /[mm] /[mrad] /[mm] /[mrad] /[mm] /[%]

Det = 0.99993

Beam (sig): 3.066, 2.842, 0.738, 11.549, 0, 0.07

Buttons: Dispersive (Dipole), Ok, Cancel, Help, Spectrometer matrix

Import COSY map

Second and Higher orders flags will be done automatically after COSY map import

after COSY map import

to edit second order matrices

**Optical matrix - D1**

$G_i = L_i * G_{i-1}$   
 G - Global, L - Block (Local)

Dimension: mm  cm

Matrices: Block (local)  Global

Second Order LOCAL matrix: Non  Exist  only for Monte Carlo transmission

Block matrix:

1. X	-2.3036	0.0009	0	0	0	2.8887	1
2. T	10.7569	-0.4383	0	0	0	-0.0001	2
3. Y	0	0	0.7508	0.0012	0	0	3
4. F	0	0	37.3513	1.3905	0	0	4
5. L	3.1073	-0.1266	0	0	1	-0.2422	5
6. D	0	0	0	0	0	1	6

/[cm]    /[mrad]    /[cm]    /[mrad]    /[cm]    /[%]

Det = 0.99915

Global matrix:

	-2.3036	0.0009	0	0	0	2.8887	[cm]
	10.7569	-0.4383	0	0	0	-0.0001	[mrad]
	0	0	0.7508	0.0012	0	0	[cm]
	0	0	37.3513	1.3905	0	0	[mrad]
	3.1073	-0.1266	0	0	1	-0.2422	[cm]
	0	0	0	0	0	1	[%]

/[cm]    /[mrad]    /[cm]    /[mrad]    /[cm]    /[%]

Det = 0.99915

Beam (sig):

0.307
2.841
0.076
11.734
0.821
0.07

2-nd order view

Buttons: Dispersive (Dipole), Ok, Cancel, Help, Spectrometer matrix

to list information about all orders

**Second order matrix: local 1 (d[x]/dd)**

Block matrix:

1. X	-0.279	0	0	0	0	0	[cm]
2. T	0.0181	-0.0003	0	0	0	0	[mrad]
3. Y	0	0	-0.1532	0	0	0	[cm]
4. F	0	0	-0.0161	-0.0004	0	0	[mrad]
5. L	0	0	0	0	0	0	[cm]
6. D	0.0386	0.0009	0	0	0	-0.0225	[%]

/[cm]    /[mrad]    /[cm]    /[mrad]    /[cm]    /[%]

Det = 0.00000

Dimension: mm  cm

Buttons: Ok, Cancel

Block: "D1" Matrices: "LOCAL"  
Block: "D1" Matrices: "LOCAL"

transport format [cm-mrad]

```

* TRANSFORM 1 *
1 [X]: -2.3036e+00 +9.0000e-04 0 0 0 0 +2.8887e+00
2 [T]: +1.0757e+01 -4.3830e-01 0 0 0 0 -1.0000e-04
3 [Y]: 0 0 +7.5080e-01 +1.2000e-03 0 0 0
4 [F]: 0 0 +3.7351e+01 +1.3905e+00 0 0 0
5 [L]: +3.1073e+00 -1.2660e-01 0 0 +1.0000e+00 -2.4220e-01
6 [D]: 0 0 0 0 0 0 +1.0000e+00

* TRANSFORM 2 *
1 1: -2.7903e-01
1 2: +1.8142e-02 -2.9247e-04
1 3: 0 0 -1.5316e-01
1 4: 0 0 -1.6070e-02 -4.1624e-04
1 5: 0 0 0 0 0
1 6: +3.8644e-02 +8.5404e-04 0 0 0 -2.2464e-02

2 1: -2.7199e-01
2 2: +2.1693e-02 -3.6461e-04
2 3: 0 0 -1.0629e+00
2 4: 0 0 -9.6810e-02 -2.1977e-03
2 5: 0 0 0 0 0
2 6: -3.0235e-01 -1.1223e-02 0 0 0 +1.9429e-01

3 1: 0 0
3 2: 0 0
3 3: -2.8757e-01 +5.1944e-03 0
3 4: -1.3859e-02 +2.6858e-04 0 0
3 5: 0 0 0 0 0
3 6: 0 0 +2.3297e-02 -2.3780e-03 0 0

4 1: 0 0
4 2: 0 0
4 3: -3.3953e+00 +7.7000e-02 0
4 4: -1.6219e-01 +3.8620e-03 0 0
4 5: 0 0 0 0 0
4 6: 0 0 -1.0814e+00 -1.6314e-01 0 0

5 1: -8.0222e-02
5 2: +4.5904e-03 -1.2334e-04
5 3: 0 0 -2.3695e-01
5 4: 0 0 -2.4642e-02 -7.9136e-04
5 5: 0 0 0 0 0
5 6: -1.5082e-02 -2.5739e-03 0 0 0 -1.5881e-02

6 1: 0 0
6 2: 0 0
6 3: 0 0
6 4: 0 0
6 5: 0 0
6 6: 0 0

* TRANSFORM 3 and higher *
N Order Parameter COSY value
1 3 X / XXX 1-300000 +2.4969e-03
2 3 T / XXX 2-300000 +6.8227e-03
3 3 L / XXX 5-300000 +1.7176e-03
4 3 X / XXT 1-210000 -3.6697e-04
5 3 T / XXT 2-210000 -7.6649e-04
6 3 L / XXT 5-210000 -2.2780e-04
7 3 X / XTT 1-120000 +1.3977e-05
8 3 T / XTT 2-120000 +2.7198e-05
    
```

Block: "D1" Matrices: "LOCAL"  
Block: "D1" Matrices: "LOCAL"

transport format [mm-mrad]

```

* TRANSFORM 1 *
1 [X]: -2.3036e+00 +9.0000e-03 0 0 0 0 +2.8887e+01
2 [T]: +1.0757e+00 -4.3830e-01 0 0 0 0 -1.0000e-04
3 [Y]: 0 0 +7.5080e-01 +1.2000e-02 0 0 0
4 [F]: 0 0 +3.7351e+00 +1.3905e+00 0 0 0
5 [L]: +3.1073e+00 -1.2660e+00 0 0 +1.0000e+00 -2.4220e+00
6 [D]: 0 0 0 0 0 0 +1.0000e+00

* TRANSFORM 2 *
1 1: -2.7903e-02
1 2: +1.8142e-02 -2.9247e-03
1 3: 0 0 -1.5316e-02
1 4: 0 0 -1.6070e-02 -4.1624e-03
1 5: 0 0 0 0 0
1 6: +3.8644e-02 +8.5404e-03 0 0 0 -2.2464e-01

2 1: -2.7199e-03
2 2: +2.1693e-03 -3.6461e-04
2 3: 0 0 -1.0629e-02
2 4: 0 0 -9.6810e-03 -2.1977e-03
2 5: 0 0 0 0 0
2 6: -3.0235e-02 -1.1223e-02 0 0 0 +1.9429e-01

3 1: 0 0
3 2: 0 0
3 3: -2.8757e-02 +5.1944e-03 0
3 4: -1.3859e-02 +2.6858e-03 0 0
3 5: 0 0 0 0 0
3 6: 0 0 +2.3297e-02 -2.3780e-02 0 0

4 1: 0 0
4 2: 0 0
4 3: -3.3953e-02 +7.7000e-03 0
4 4: -1.6219e-02 +3.8620e-03 0 0
4 5: 0 0 0 0 0
4 6: 0 0 -1.0814e-01 -1.6314e-01 0 0

5 1: -8.0222e-03
5 2: +4.5904e-03 -1.2334e-03
5 3: 0 0 -2.3695e-02
5 4: 0 0 -2.4642e-02 -7.9136e-03
5 5: 0 0 0 0 0
5 6: -1.5082e-02 -2.5739e-02 0 0 0 -1.5881e-01

6 1: 0 0
6 2: 0 0
6 3: 0 0
6 4: 0 0
6 5: 0 0
6 6: 0 0

* TRANSFORM 3 and higher *
N Order Parameter COSY value
1 3 X / XXX 1-300000 +2.4969e-05
2 3 T / XXX 2-300000 +6.8227e-06
3 3 L / XXX 5-300000 +1.7176e-05
4 3 X / XXT 1-210000 -3.6697e-05
5 3 T / XXT 2-210000 -7.6649e-06
6 3 L / XXT 5-210000 -2.2780e-05
7 3 X / XTT 1-120000 +1.3977e-05
8 3 T / XTT 2-120000 +2.7198e-05
    
```



# LISE++ file and high orders



```

C:\user\c\lise_pp_83\files\A1900_FifthOrder_open.lpp
Highest = 39Ar ; Mass ElementName Charge+ Beam

{----- BLOCK D1 - Dipole -----}

[D1_General]
Name = D1.1 ; Name of Block, Constant name 1/0
Available = 1 ; Use 1/0, Show 1/0
Length = 8.719000 m ; Length block for optical blocks
SecondOrder = 1 ; Exist = 1 Non = 0
ThirdOrder = 584 ; Number of lines
Before_Quad = 3 ; number of quadrupoles before optic device
After_Quad = 3 ; number of quadrupoles after optic device
QA_DontDraw = 0
QB_DontDraw = 0
QA_Draw = 0
QB_Draw = 0
ZnQ = 0 ; Z - Q = charge state settings
Calibration file = A1900\A1900_D1-Z026.cal

[D1_slits]
Shape = 0 ; 0-slits, 1-ellipse
X_action = 1.0 ; Use 1/0, Show 1/0
X_size = 1,-100.00,-150.0,100.00,150.0 ; joint.Left,L-limit.Right,R-limit
Y_action = 1.0 ; Use 1/0, Show 1/0
Y_size = 1,-100.00,-150.0,100.00,150.0 ; joint.Bottom,B-limit.Top,T-limit

[D1_optics]
row1 = -2.3036e+00,+9.0000e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+2.8887e+01
row2 = +1.0757e+00,-4.3830e-01,+0.0000e+00,+0.0000e+00,+0.0000e+00,-1.0000e-04
row3 = +0.0000e+00,+0.0000e+00,+7.5080e-01,+1.2000e-02,+0.0000e+00,+0.0000e+00
row4 = +0.0000e+00,+0.0000e+00,+3.7351e+00,+1.3905e+00,+0.0000e+00,+0.0000e+00
row5 = +3.1073e+00,-1.2660e+00,+0.0000e+00,+0.0000e+00,+1.0000e+00,-2.4220e+00
row6 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+1.0000e+00

[D1_optics2]
row11 = -2.7903e-02,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row12 = +1.8142e-02,-2.9247e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row13 = +0.0000e+00,+0.0000e+00,+0.0000e+00,-1.5316e-02,+0.0000e+00,+0.0000e+00
row14 = +0.0000e+00,+0.0000e+00,-1.6070e-02,-4.1624e-03,+0.0000e+00,+0.0000e+00
row15 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row16 = +3.8644e-02,+8.5404e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,-2.2464e-01
row21 = -2.7199e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row22 = +2.1693e-03,-3.6461e-04,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row23 = +0.0000e+00,+0.0000e+00,+0.0000e+00,-1.0629e-02,+0.0000e+00,+0.0000e+00
row24 = +0.0000e+00,+0.0000e+00,-9.6810e-03,-2.1977e-03,+0.0000e+00,+0.0000e+00
row25 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row26 = -3.0235e-02,-1.1223e-02,+0.0000e+00,+0.0000e+00,+0.0000e+00,+1.9429e-01
row31 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row32 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row33 = -2.8757e-02,+5.1944e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row34 = -1.3859e-02,+2.6858e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row35 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row36 = +0.0000e+00,+0.0000e+00,+2.3297e-02,-2.3780e-02,+0.0000e+00,+0.0000e+00
row41 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row42 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row43 = -3.3953e-02,+7.7000e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row44 = -1.6219e-02,+3.8620e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row45 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row46 = +0.0000e+00,+0.0000e+00,-1.0814e-01,-1.6314e-01,+0.0000e+00,+0.0000e+00
row51 = -8.0222e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row52 = +4.5904e-03,-1.2334e-03,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row53 = +0.0000e+00,+0.0000e+00,-2.3695e-02,+0.0000e+00,+0.0000e+00,+0.0000e+00
row54 = +0.0000e+00,+0.0000e+00,-2.4642e-02,-7.9136e-03,+0.0000e+00,+0.0000e+00
row55 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row56 = -1.5082e-02,-2.5739e-02,+0.0000e+00,+0.0000e+00,+0.0000e+00,-1.5881e-01
row61 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row62 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row63 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row64 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row65 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00
row66 = +0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00,+0.0000e+00

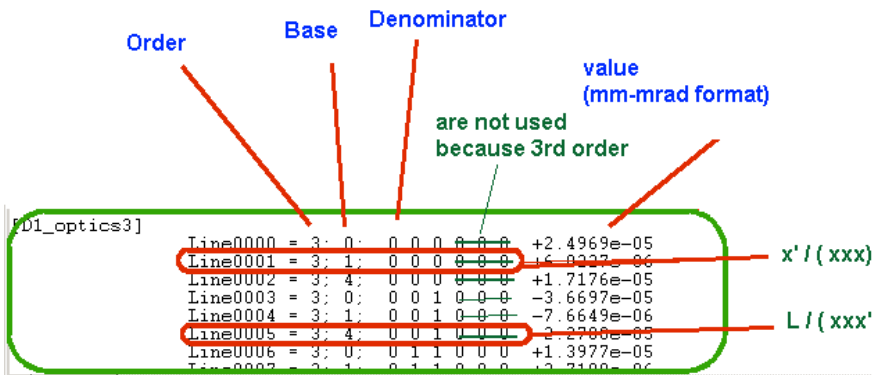
[D1_optics3]
Line0000 = 3: 0: 0 0 0 0 0 0 +2.4969e-05
Line0001 = 3: 1: 0 0 0 0 0 0 +6.8227e-06
Line0002 = 3: 4: 0 0 0 0 0 0 +1.7176e-05
Line0003 = 3: 0: 0 0 1 0 0 0 -3.6697e-05
Line0004 = 3: 1: 0 0 1 0 0 0 -7.6649e-06
Line0005 = 3: 4: 0 0 1 0 0 0 -3.2700e-05
Line0006 = 3: 0: 0 0 1 1 0 0 0 +1.3977e-05
Line0007 = 3: 1: 0 0 1 1 0 0 0 +3.2100e-06

```

LISE++ keeps all information in files, as well as all calculates in mm-mrad format!

LISE++ A1900 files

- 1<sup>st</sup> order ~ 59 kB
- 3<sup>rd</sup> order ~ 112 kB
- 5<sup>th</sup> order ~ 231 kB





The user can manipulate with order to plot MC results

LISE++ defines automatically the highest order and make buttons enable/disable

**MC transmission options**

High Order Optics Calculations

Use in calculations :

only 1-st order   
  through 3rd order   
  through 4th order   
  through 5th order

Highest Order in this configuration:

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

\* No resolution will be taken into account if the selected block is optical or wedge

\* Only energy resolution of first detector after the selected block will be taken into account for TKE value

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 options

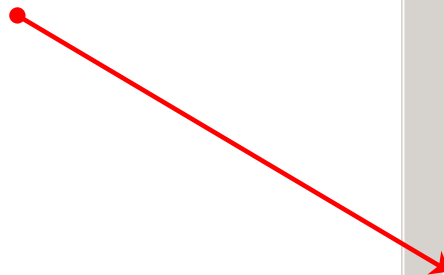
Assume the reaction takes place at the middle of target

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

Make default

Information about the set order,

Clicking on this icon you can cyclically change order



## Calculation Speed

(A1900 configuration)

1<sup>st</sup> order ~ 3600 cps

2<sup>nd</sup> order ~ 3400 cps

3<sup>rd</sup> order ~ 2500 cps

4<sup>th</sup> order ~ 1900 cps

5<sup>th</sup> order ~ 1200 cps

Emittance

Beam CARD  
[sigma]

1. X	3	mm
2. T	6	mrاد
3. Y	3	mm
4. P	6	mrاد
5. L	0	mm
6. D	0.07	%

Gate for Monte Carlo calculation transmission

Coordinate  
After BLOCK  
Stripper

Status (Condition)

absent

"AND "

"NOT "

Gate

v1 = -2

v2 = 2

OK

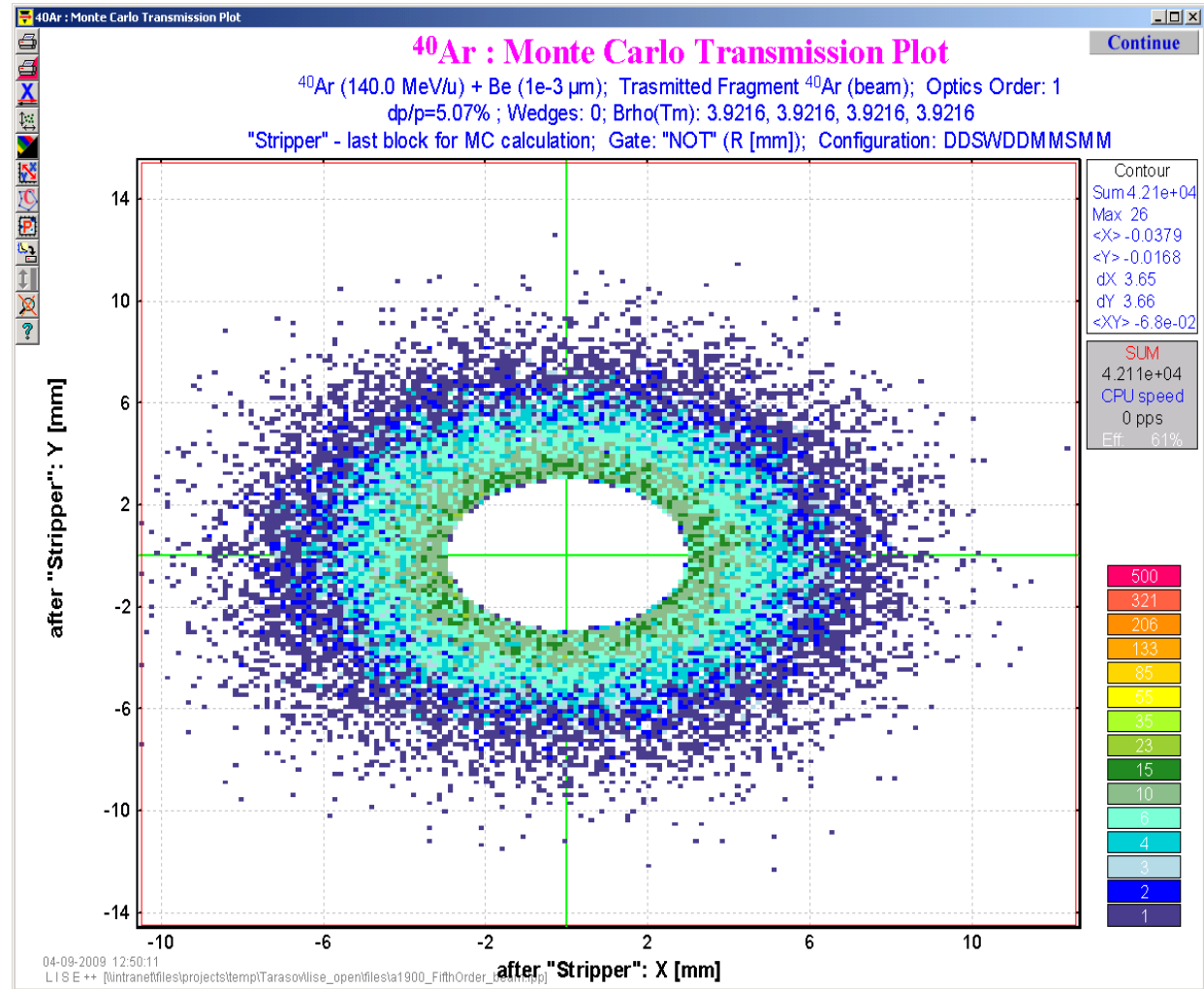
Cancel

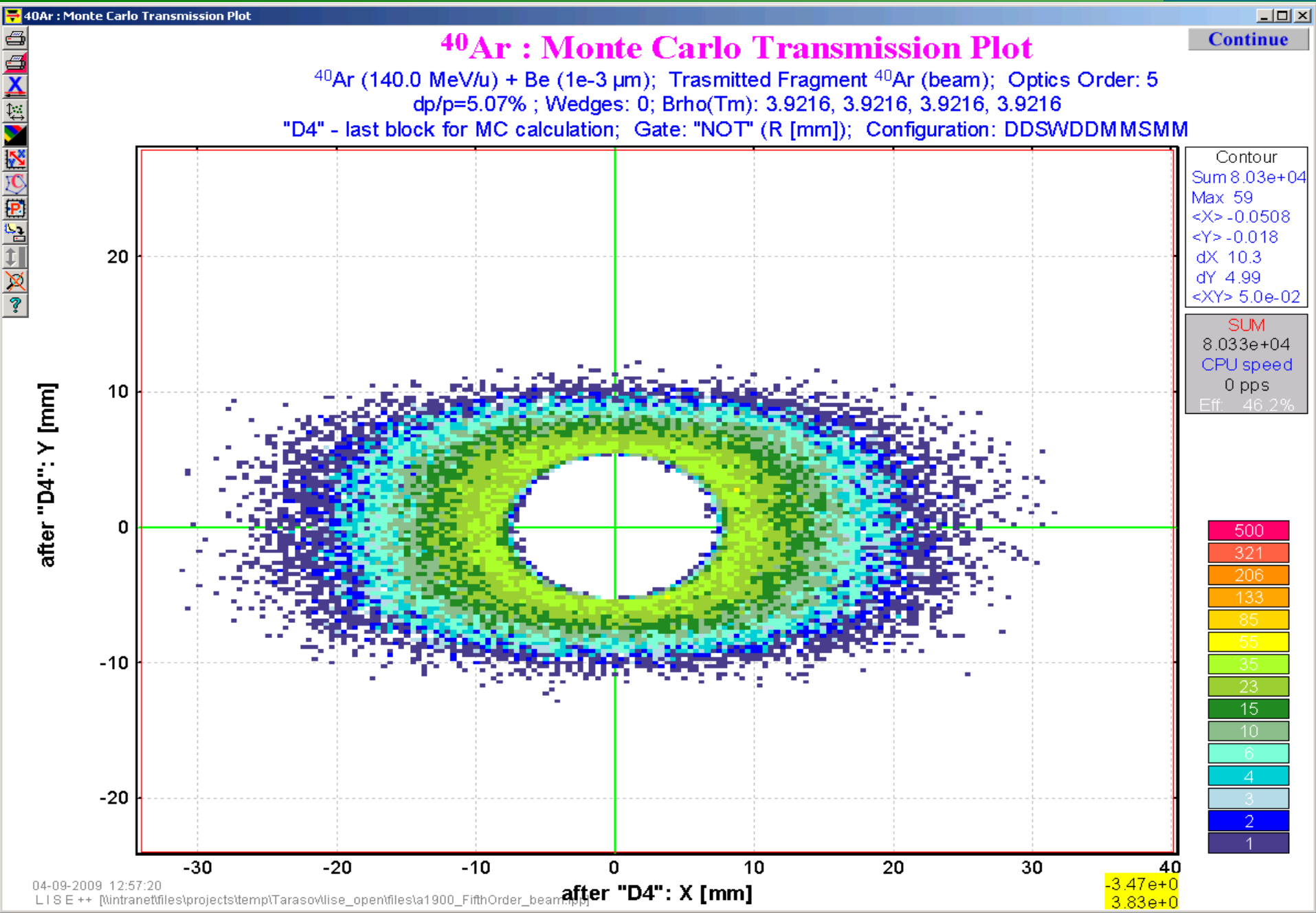
Coordinate

X mm  
 X' (T) mrad  
 Y mm  
 Y' (P) mrad  
 dP/P %  
 R [(X;Y)] mm  
 A [(X';Y')] mrad  
 Energy MeV/u  
 TKE MeV  
 Momentum MeV/c  
 Brho T\*m  
 Velocity cm/ns  
 Energy Loss MeV  
 Range mm  
 Energy Deposition MeV/mm /particle  
 Time of flight ns  
 Length m

Start Stripper

Stop Stripper





40Ar : Monte Carlo Transmission Plot

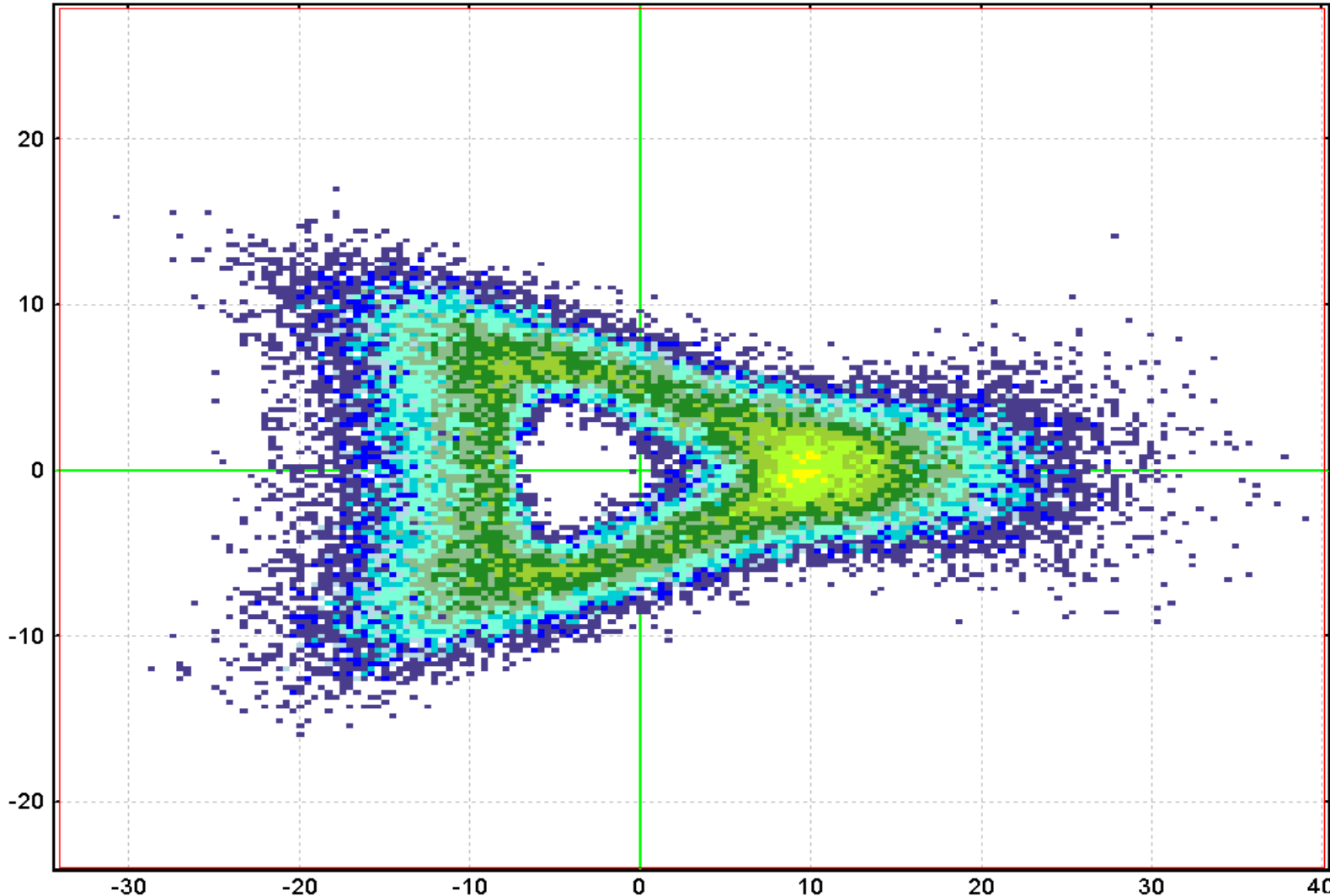
## 40Ar : Monte Carlo Transmission Plot

40Ar (140.0 MeV/u) + Be (1e-3 μm); Transmitted Fragment 40Ar (beam); Optics Order: 5  
 dp/p=5.07% ; Wedges: 0; Brho(Tm): 3.9216, 3.9216, 3.9216, 3.9216

"D4" - last block for MC calculation; Gate: "NOT" (R [mm]); Configuration: DDSWDDMMSSMM

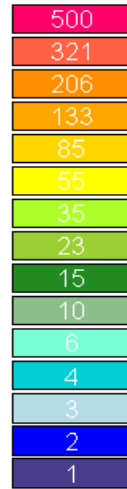
Continue

after "D4": Y [mm]



Contour  
 Sum 5.71e+04  
 Max 72  
 <X> 0.507  
 <Y> -0.00474  
 dX 10.8  
 dY 4.84  
 <XY> -2.6e-01

SUM  
 5.708e+04  
 CPU speed  
 0 pps  
 Eff 45.8%



40Ar : Monte Carlo Transmission Plot

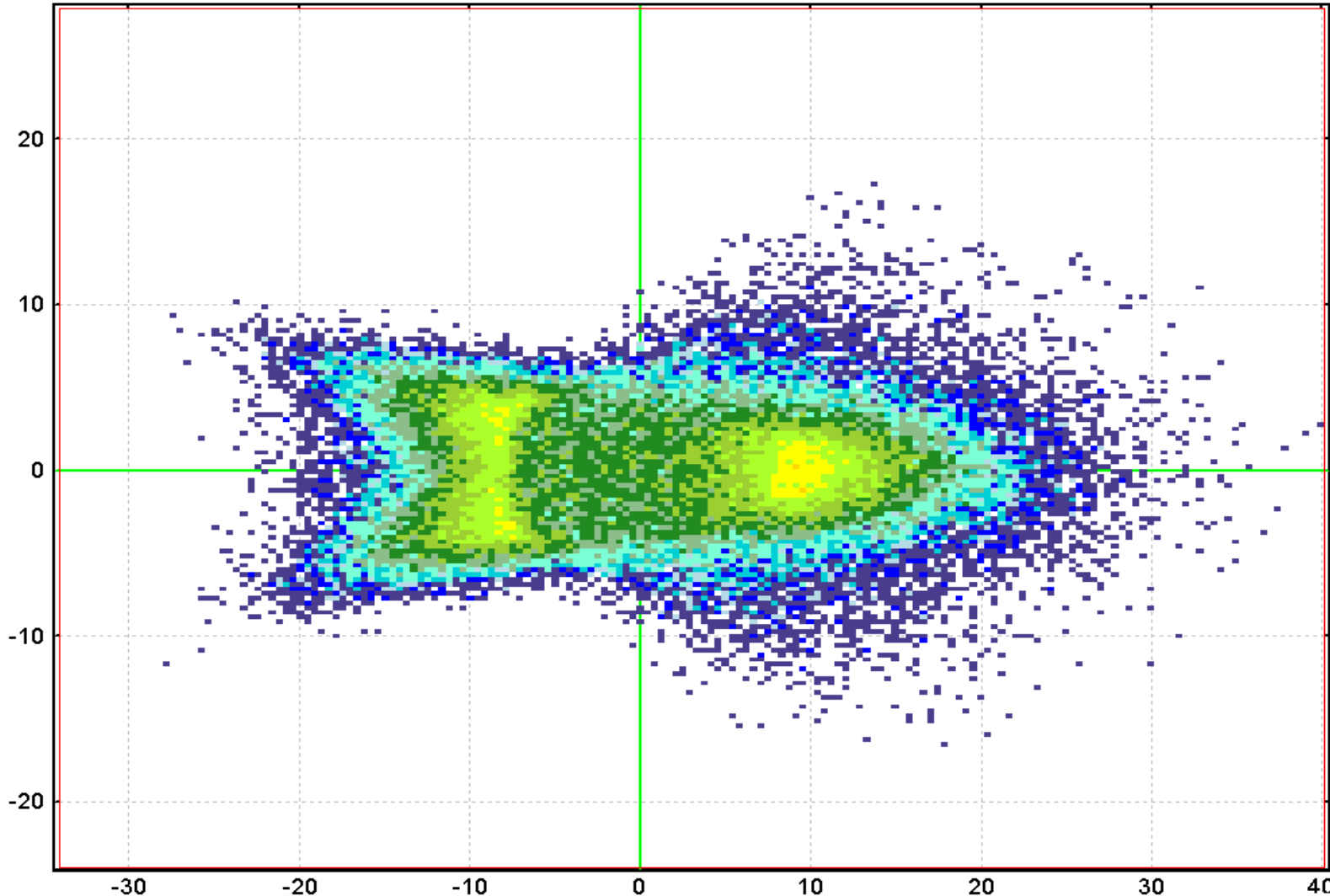
## 40Ar : Monte Carlo Transmission Plot

40Ar (140.0 MeV/u) + Be (1e-3 μm); Trasmitted Fragment 40Ar (beam); Optics Order: 5  
 dp/p=5.07% ; Wedges: 0; Brho(Tm): 3.9216, 3.9216, 3.9216, 3.9216

"D4" - last block for MC calculation; Gate: "NOT" (R [mm]); Configuration: DDSWDDMMSSMM

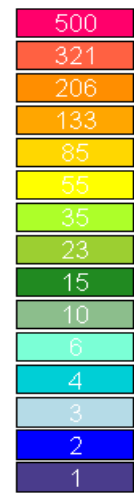
Continue

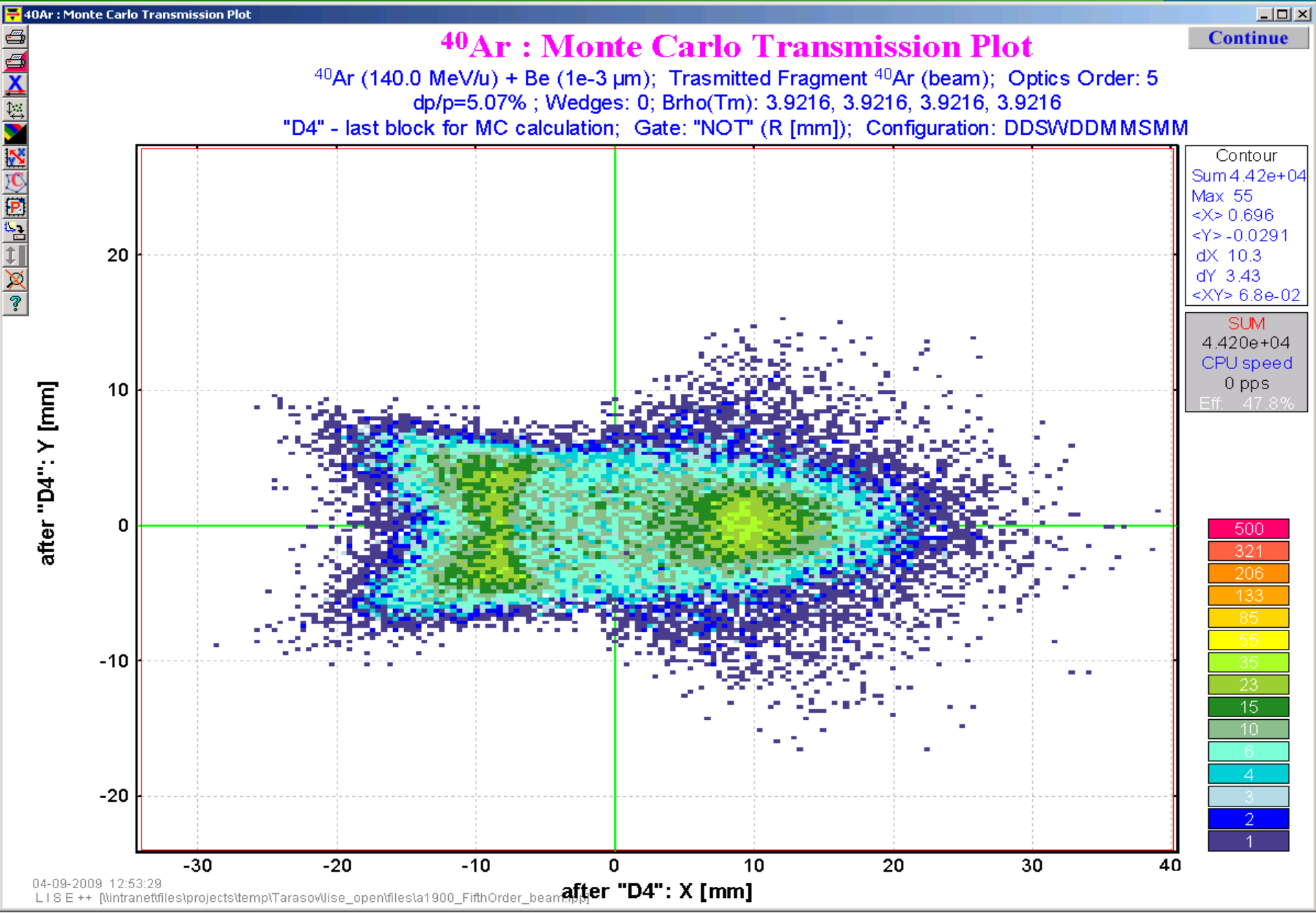
after "D4": Y [mm]

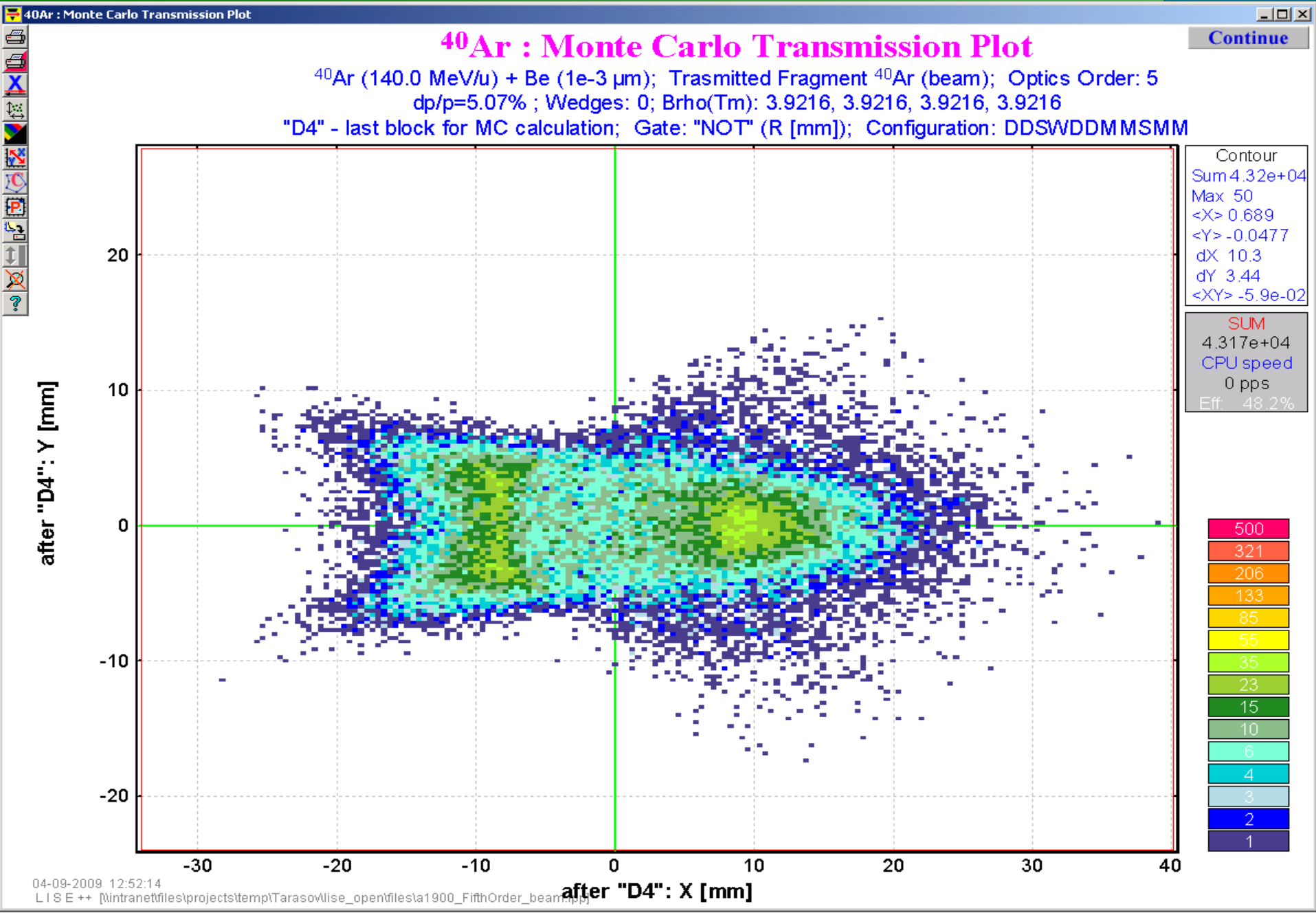


Contour  
 Sum 7.8e+04  
 Max 91  
 <X> 0.645  
 <Y> -0.0266  
 dX 10.3  
 dY 3.41  
 <XY> -3.0e-02

SUM  
 7.802e+04  
 CPU speed  
 0 pps  
 Eff 48%









# Example 2 – Image4 : order 5, Y' vs. X'

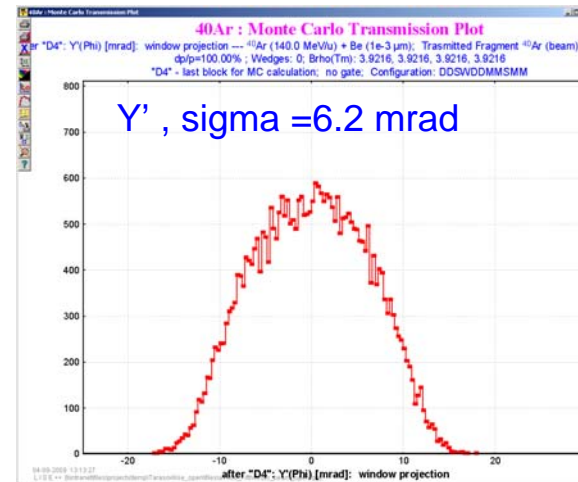
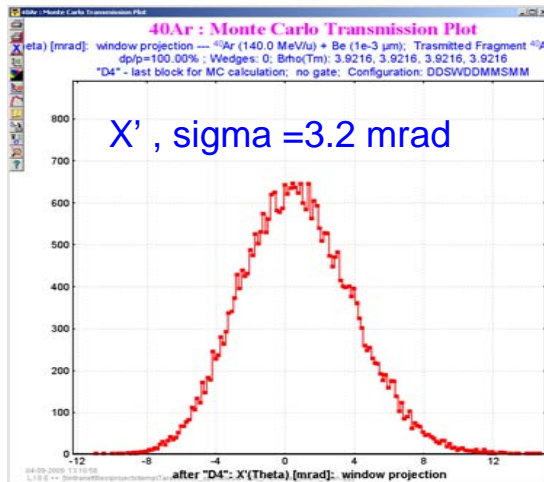
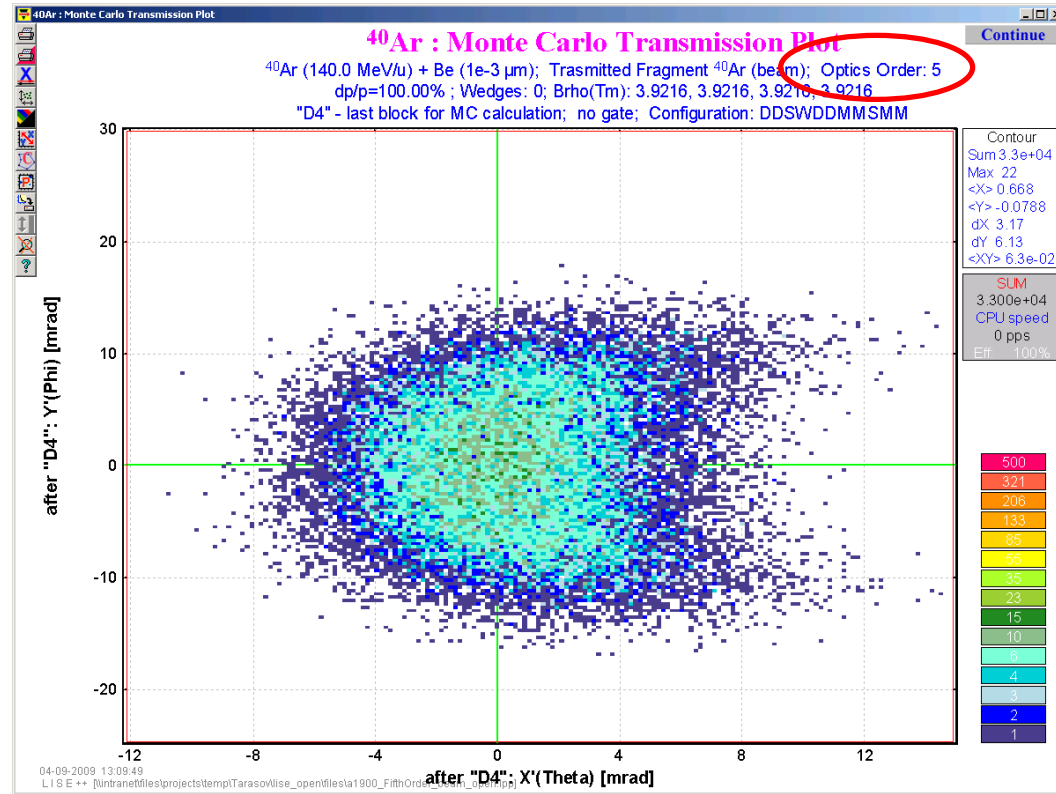
Emittance

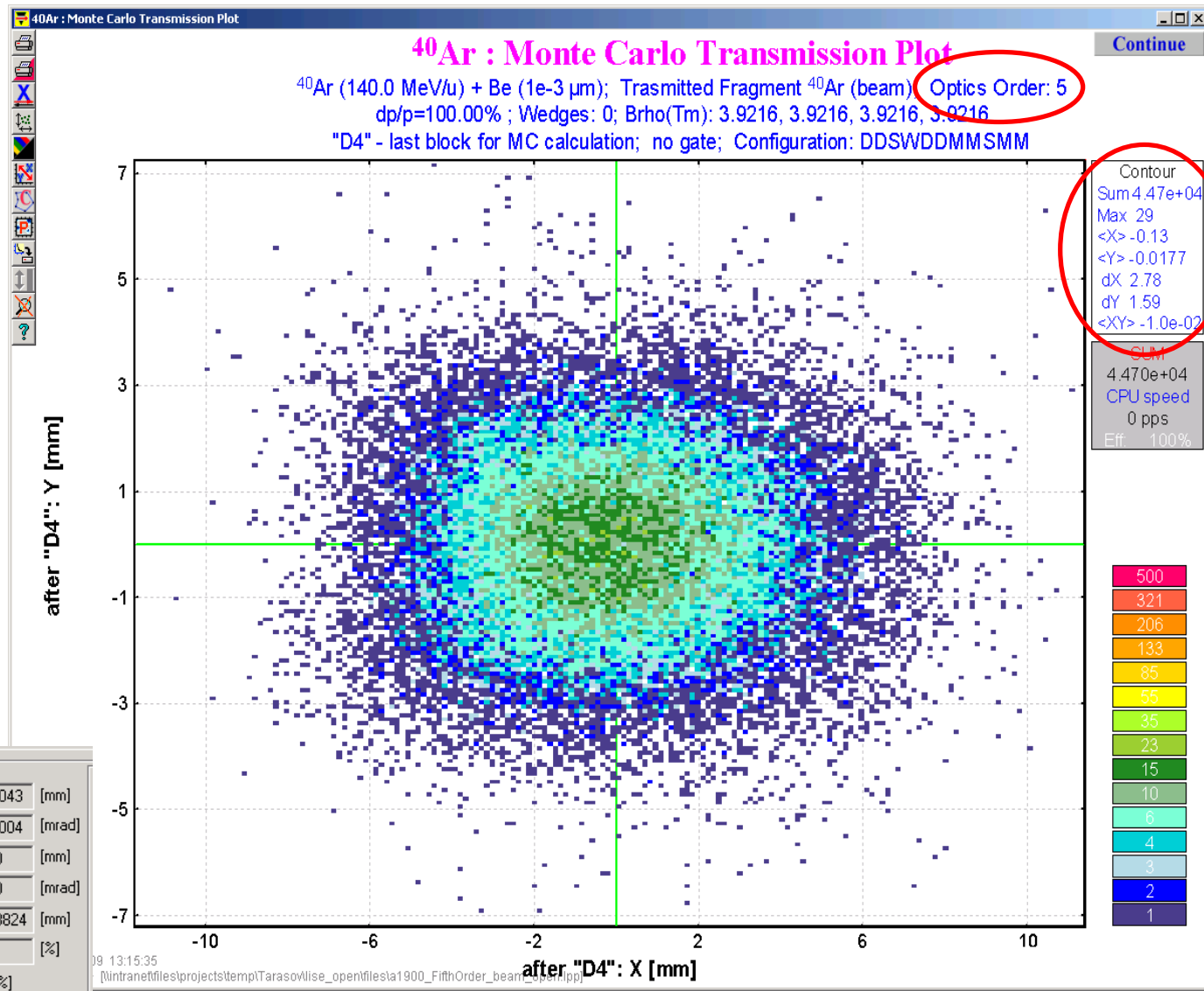
Beam CARD (sigma)

1. X	1	mm
2. T	7	mrاد
3. Y	1	mm
4. P	7	mrاد
5. L	0	mm
6. D	0.07	%

Global matrix

2.6917	-0.0722	0	0	0	-0.0043	[mm]
-1.0586	0.3999	0	0	0	-0.0004	[mrad]
0	0	1.8167	0.0052	0	0	[mm]
0	0	6.4009	0.5695	0	0	[mrad]
0	0.0001	0	0	1	-10.8824	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	





Emittance

Beam CARD (sigma)

1. X	1	mm
2. T	7	mrad
3. Y	1	mm
4. P	7	mrad
5. L	0	mm
6. D	0.07	%

Global matrix

2.6917	-0.0722	0	0	0	-0.0043	[mm]
-1.0586	0.3999	0	0	0	-0.0004	[mrad]
0	0	1.8167	0.0052	0	0	[mm]
0	0	6.4009	0.5695	0	0	[mrad]
0	0.0001	0	0	1	-10.8824	[mm]
0	0	0	0	0	1	[%]
/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	

09 13:15:35  
 [intranetfiles\projects\temp\Tarasov\lise\_open\files\1900\_FifthOrder\_beam...]

# Example 3

Emittance		
Beam CARD (sigma)		
1. X	0.1	mm
2. T	1	mrاد
3. Y	0.1	mm
4. P	40	mrاد
5. L	0	mm
6. D	0.01	%

**Gate for Monte Carlo calculation transmission**

Status (Condition)

absent

"AND "

"NOT "

Gate

v1 =

v2 =

OK

Cancel

Coordinate

After BLOCK

Stripper

X mm

X' (T) mrاد

Y mrاد

Y' (P) mrاد

dP/P %

R [f(X,Y)] mm

A [f(X',Y')] mrاد

Energy MeV/u

TKE MeV

Momentum MeV/c

Brho T\*m

Velocity cm/ns

Energy Loss MeV

Range mm

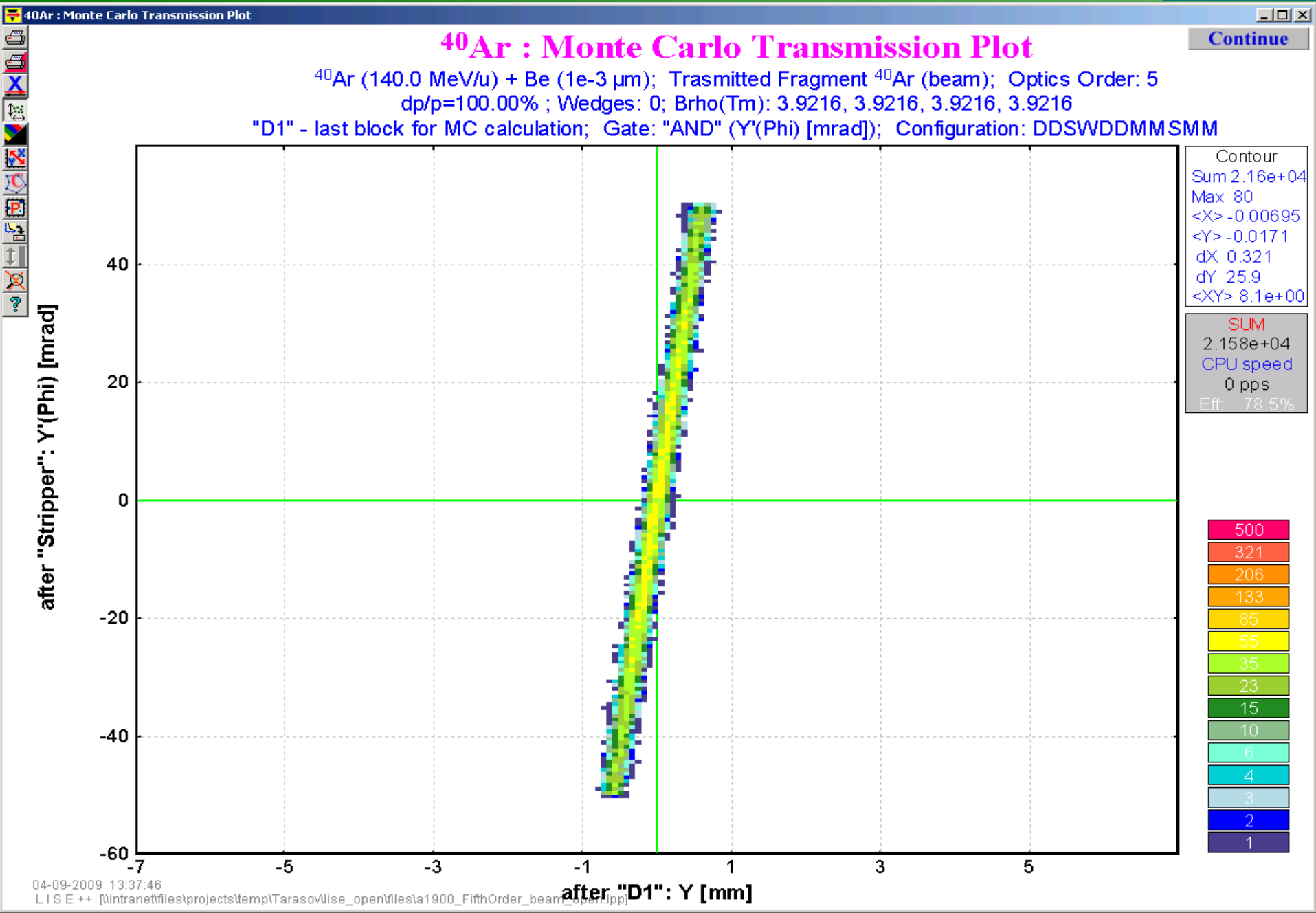
Energy Deposition MeV/mm /particle

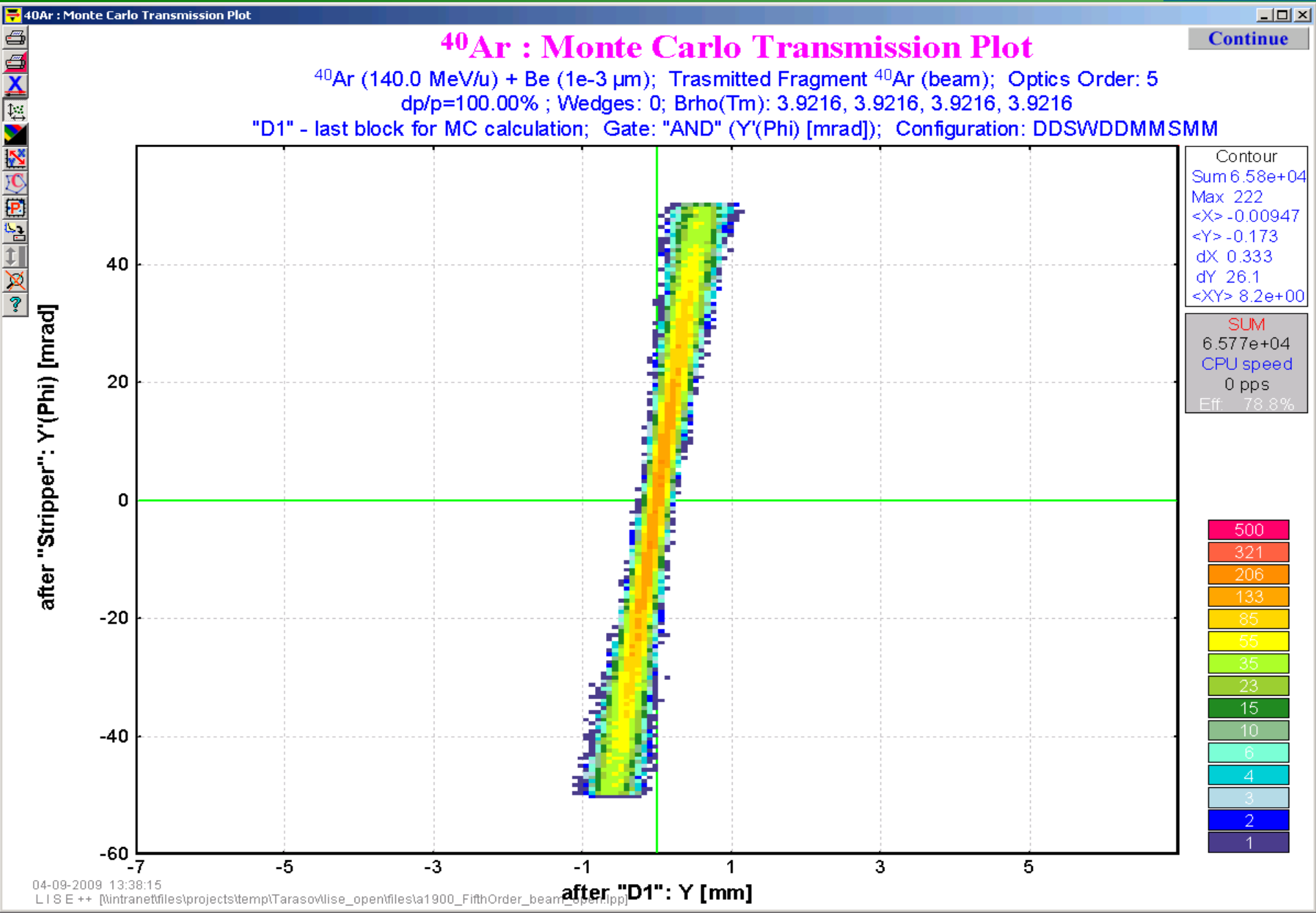
Time of flight ns

Length m

Start

Stop





40Ar : Monte Carlo Transmission Plot

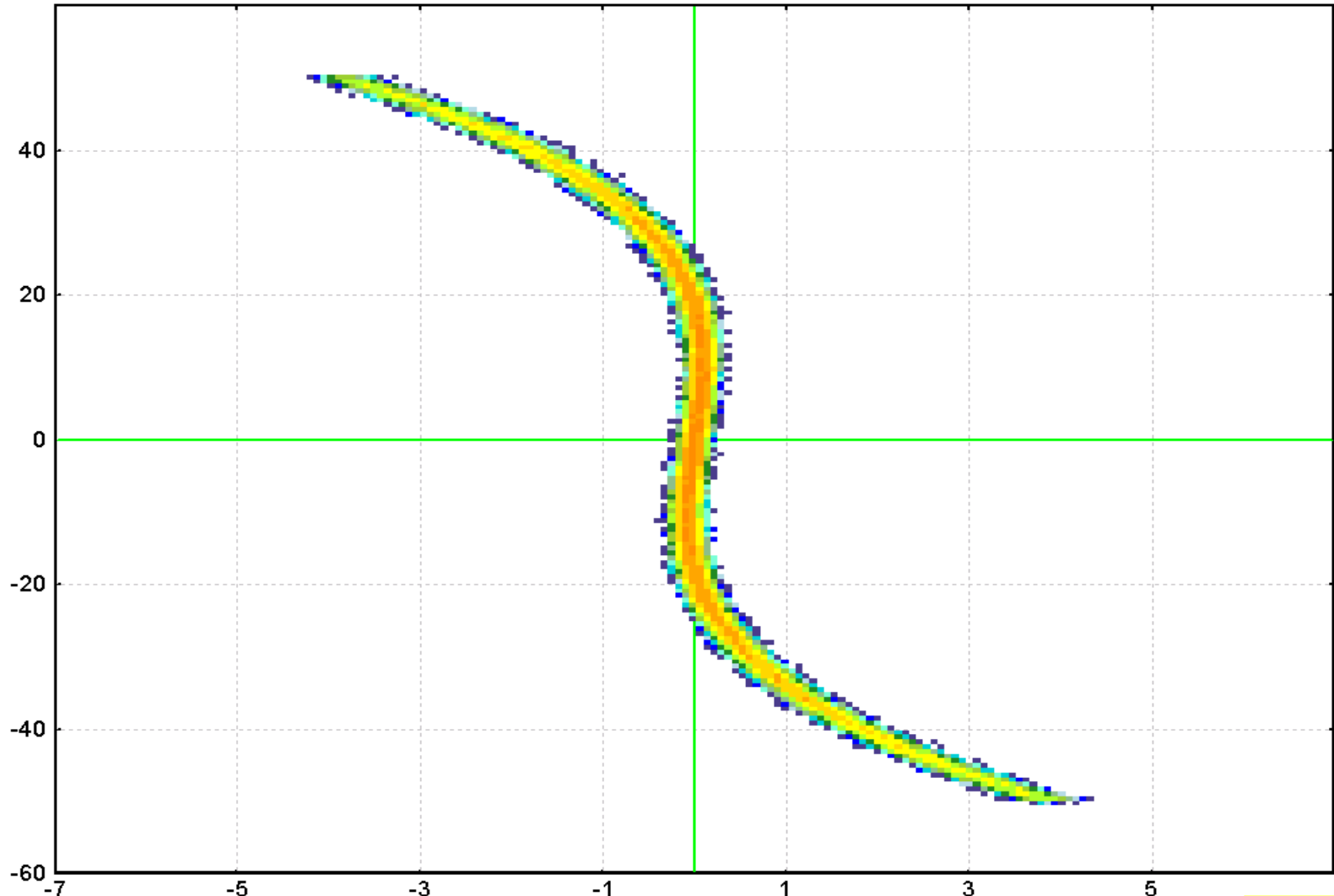
## 40Ar : Monte Carlo Transmission Plot

Continue

$^{40}\text{Ar}$  (140.0 MeV/u) + Be ( $1e-3 \mu\text{m}$ ); Transmitted Fragment  $^{40}\text{Ar}$  (beam); Optics Order: 5  
 $dp/p=100.00\%$ ; Wedges: 0; Brho(Tm): 3.9216, 3.9216, 3.9216, 3.9216

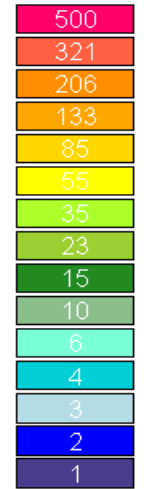
"D1" - last block for MC calculation; Gate: "AND" (Y'(Phi) [mrad]); Configuration: DDSWDDMMSSMM

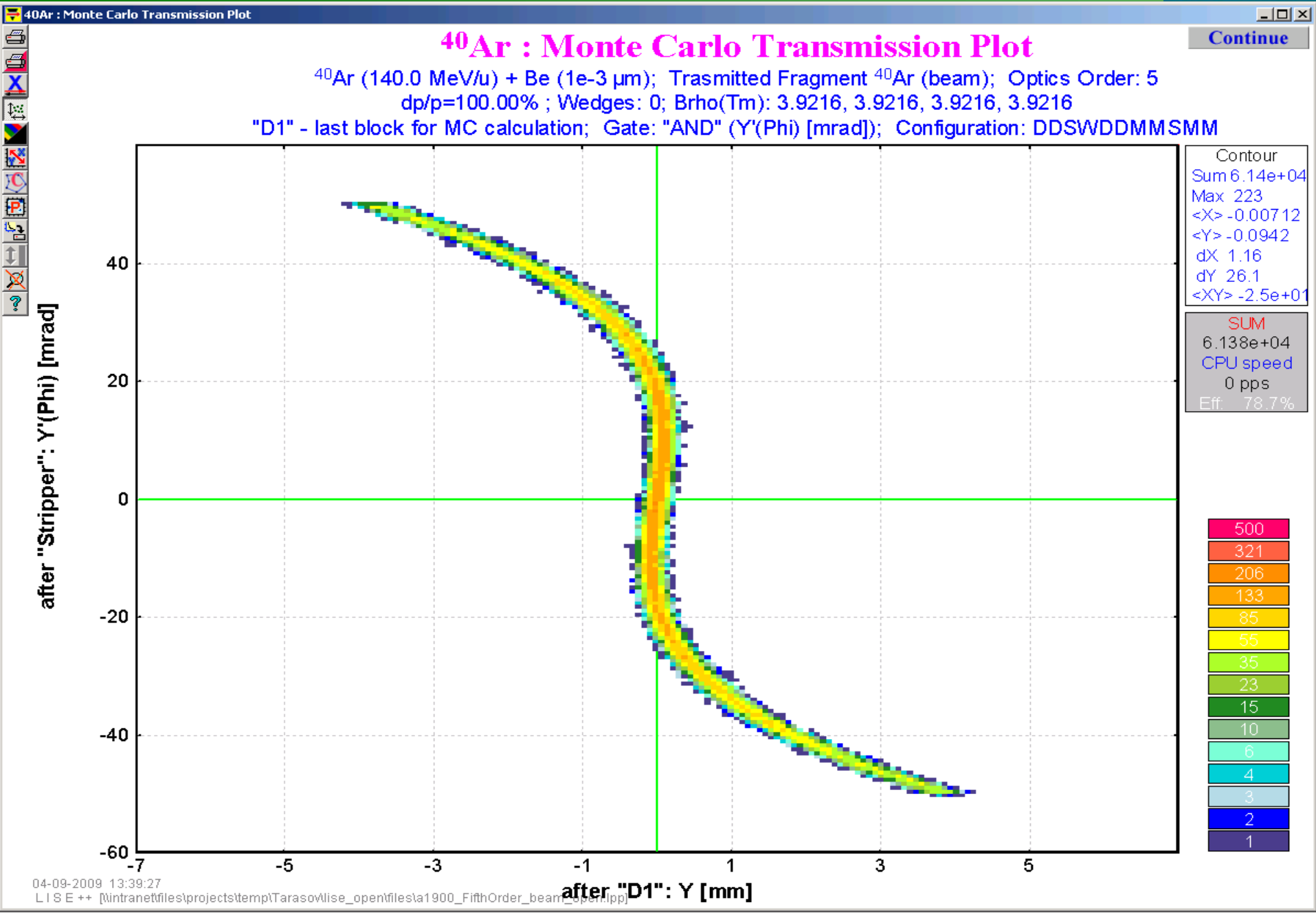
after "Stripper": Y'(Phi) [mrad]

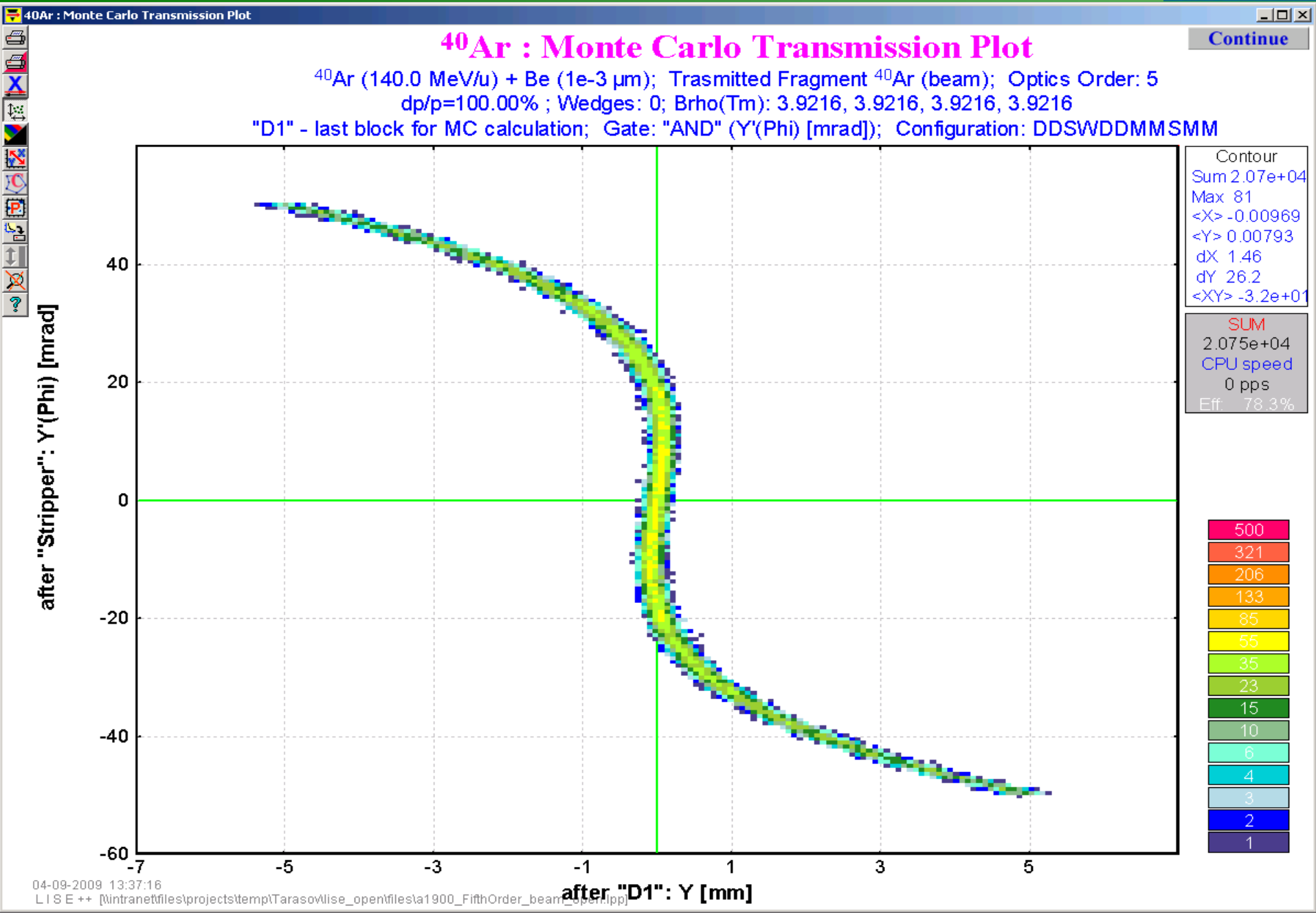


Contour  
 Sum 7.74e+04  
 Max 256  
 <X> -0.0119  
 <Y> 0.0203  
 dX 1.15  
 dY 26.1  
 <XY> -2.5e+01

SUM  
 7.741e+04  
 CPU speed  
 0 pps  
 Eff 78.6%









# Example 4 – transmission: Distribution method

statistics 40Mg

40Mg      Beta- decay (Z=12, N=28)

Q1 (D1)	12
Q2 (D2)	12
Q3 (D3)	12
Q4 (D4)	12
<b>Production Rate (pps)</b>	<b>2.82e-5</b>
Reaction	Fragmentn
Sum of all reactions (pps)	2.82e-5
CS in the target (mb)	3.21e-10
<b>Total transmission (%)</b>	<b>26.489</b>
<b>Target (%)</b>	<b>92.21</b>
X space transmission (%)	100
Y space transmission (%)	100
Unreacted in mater. (%)	92.21
Unstopped in mater. (%)	100
<b>D1 (%)</b>	<b>58.97</b>
X space transmission (%)	63.21
Y space transmission (%)	100
X angular transmissn. (%)	99.7
Y angular transmissn. (%)	93.57
<b>D2 (%)</b>	<b>73.97</b>
X space transmission (%)	74.1
Y space transmission (%)	100
X angular transmissn. (%)	100
Y angular transmissn. (%)	99.86
<b>I2 slits (%)</b>	<b>96.29</b>
X space transmission (%)	96.29
<b>I2 wedge (%)</b>	<b>99.03</b>
Unreacted in mater. (%)	99.03
Unstopped in mater. (%)	100
<b>D3 (%)</b>	<b>99.16</b>
X space transmission (%)	100
Y space transmission (%)	100
X angular transmissn. (%)	100
Y angular transmissn. (%)	99.2
<b>D4 (%)</b>	<b>89.41</b>
X space transmission (%)	100
Y space transmission (%)	100
X angular transmissn. (%)	99.85
Y angular transmissn. (%)	89.54
<b>FP PPACO (%)</b>	<b>100</b>
Unreacted in mater. (%)	100
Unstopped in mater. (%)	100

Analysis

Print

A, Z NNDC

A, Z JAEA

Z - wallet NNDC

WWW TOI (SE)

Chemistry - Mg

File Save

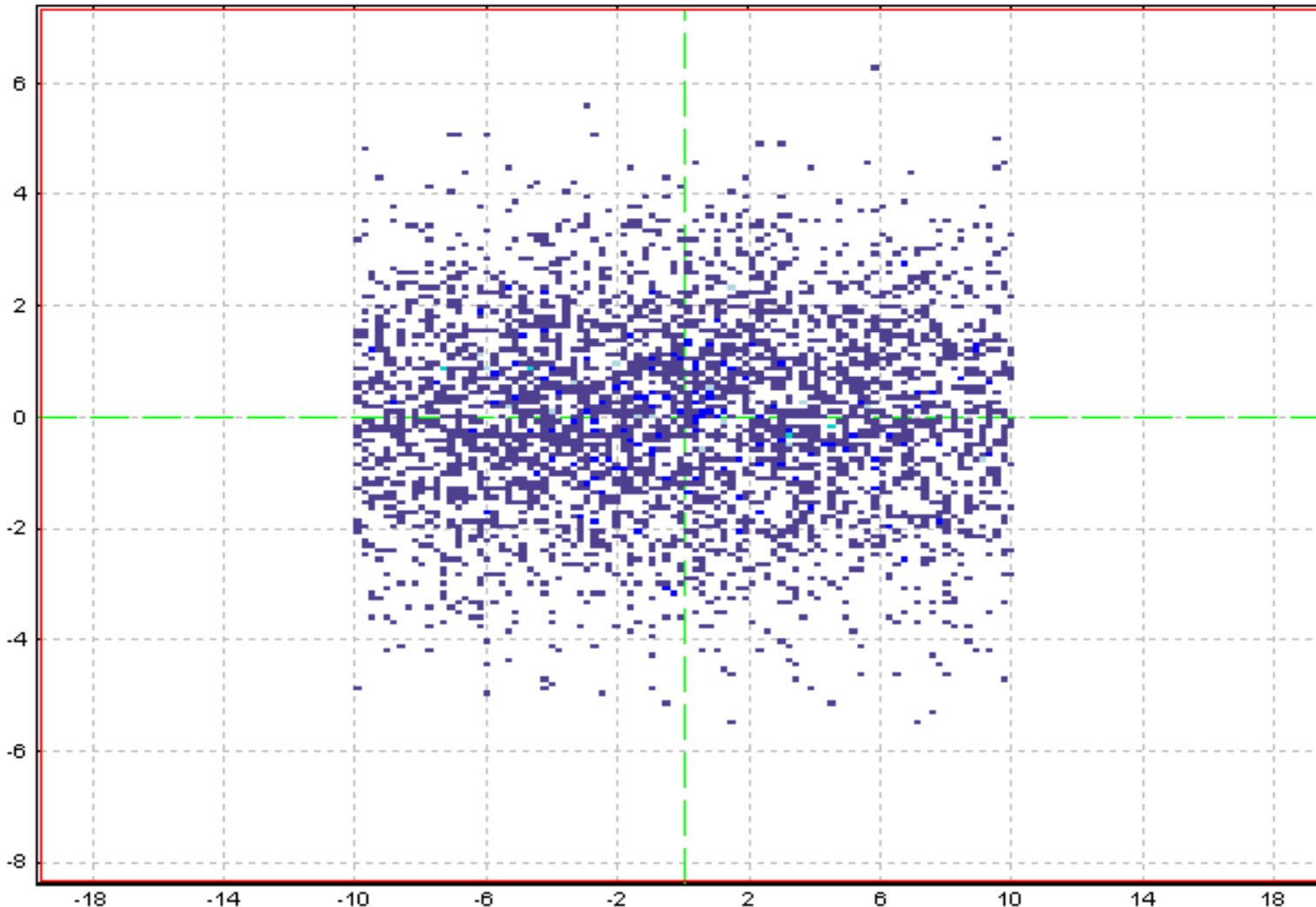
40Mg : Monte Carlo Transmission Plot

## 40Mg : Monte Carlo Transmission Plot

Continue

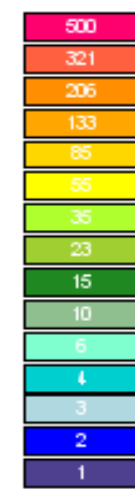
<sup>48</sup>Ca (140.0 MeV/u) + Be (795.44 mg/cm<sup>2</sup>) Transmitted Fragment <sup>40</sup>Mg (Fragmentn); Optics Order: 1  
 dp/p=5.07% ; Wedges: Al (200 mg/cm<sup>2</sup>); Brho(Tm): 5.2293, 5.2293, 5.1342, 5.1342  
 "FP\_slits" - last block for MC calculation; no gate; Configuration: DDSWDDMMSMM

after "FP\_slits": Y [mm]



**Counter**  
 Sum 3.66e+03  
 Max 5  
 <X> -0.0904  
 <Y> 0.00437  
 dX 5.31  
 dY 1.72  
 <XY> -9.0e-02

**SUM**  
 3.660e+03  
 CPU speed  
 0 dpps  
 Eff: 27.3%



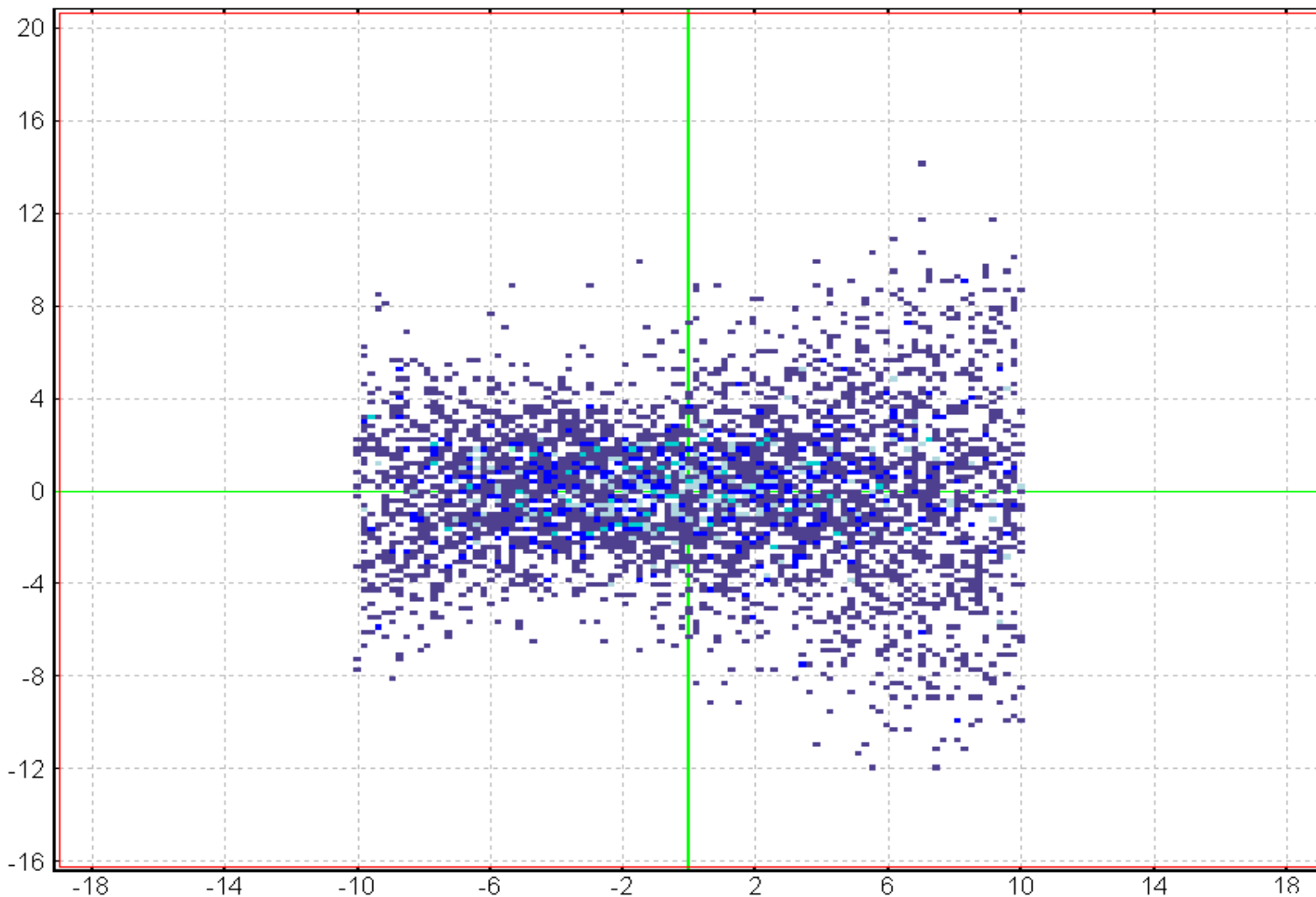
40Mg : Monte Carlo Transmission Plot

## <sup>40</sup>Mg : Monte Carlo Transmission Plot

Continue

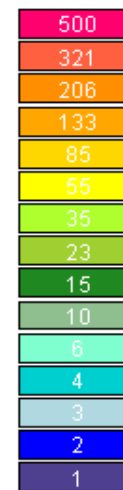
<sup>48</sup>Ca (140.0 MeV/u) + Be (795.44 mg/cm<sup>2</sup>); Trasmitted Fragment <sup>40</sup>Mg (Fragmentn); Optics Order: 2  
 dp/p=5.07% ; Wedges: Al (200 mg/cm<sup>2</sup>); Brho(Tm): 5.2293, 5.2293, 5.1342, 5.1342  
 "FP\_slits" - last block for MC calculation; no gate; Configuration: DDSWDDMMMSMM

after "FP\_slits": Y [mm]



Contour  
 Sum 4.61e+03  
 Max 7  
 <X> 0.277  
 <Y> -0.043  
 dX 5.32  
 dY 3.14  
 <XY> 1.4e-01

SUM  
 4.608e+03  
 CPU speed  
 0 pps  
 Eff 25.6%



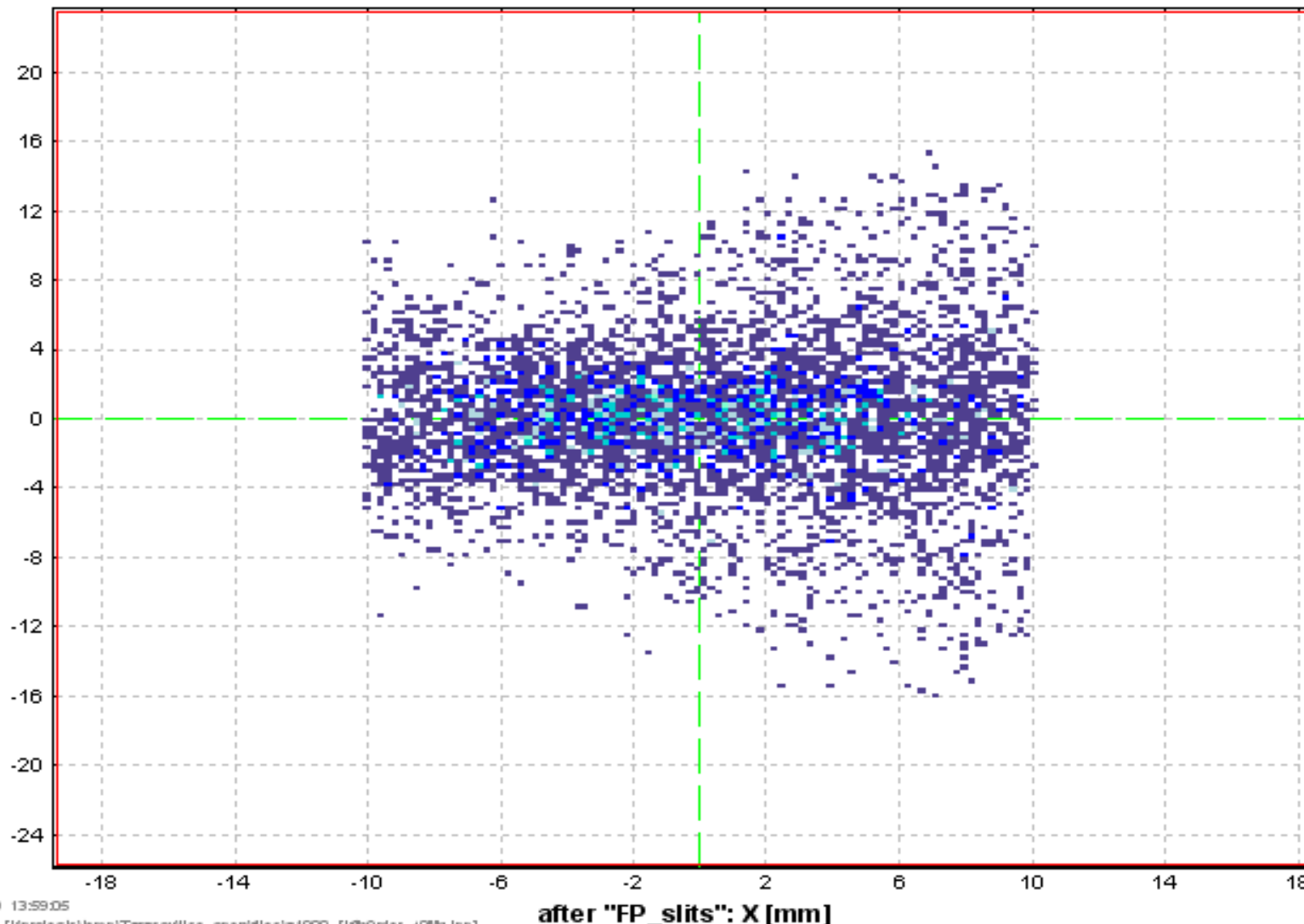
40Mg : Monte Carlo Transmission Plot

## 40Mg : Monte Carlo Transmission Plot

Continue

<sup>48</sup>Ca (140.0 MeV/u) + Be (795.44 mg/cm<sup>2</sup>) Transmitted Fragment <sup>40</sup>Mg (Fragmentn); Optics Order: 3  
 dp/p=5.07% ; Wedges: Al (200 mg/cm<sup>2</sup>) Brho(Tm) 5.2293, 5.2293, 5.1342, 5.1342  
 "FP\_slits" - last block for MC calculation; no gate; Configuration: DDSWDDMMSMM

after "FP\_slits": Y [mm]



**Contnr**  
 Sim 5.56e+03  
 Max 8  
 <X> 0.405  
 <Y> -0.0359  
 dx 5.24  
 dy 4.11  
 <XY> 1.4e-01

**SUM**  
 5.564e+03  
 CPU speed  
 0ppx  
 Eff: 26.9%

- 500
- 321
- 206
- 133
- 85
- 55
- 35
- 23
- 15
- 10
- 6
- 4
- 3
- 2
- 1

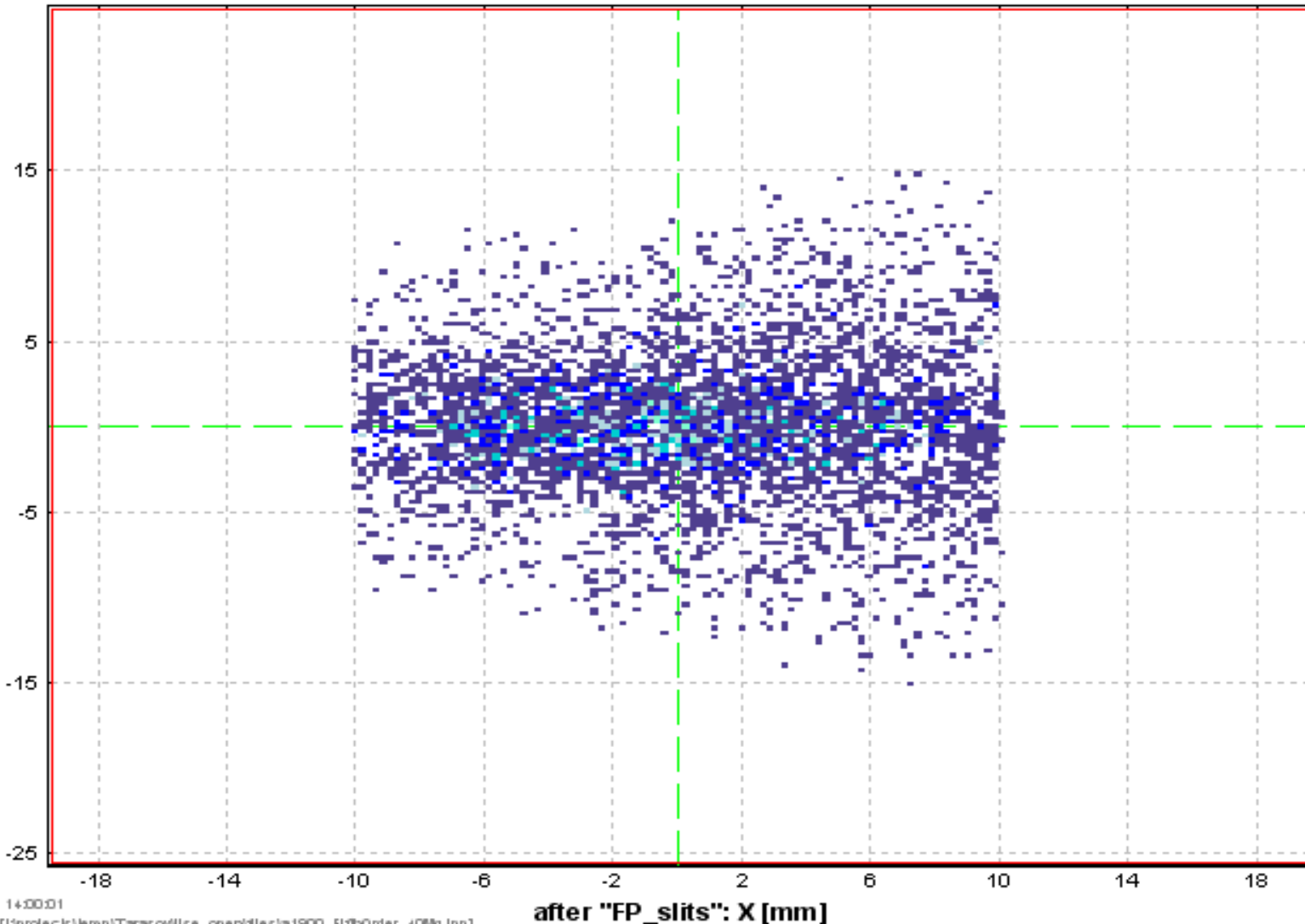
40Mg : Monte Carlo Transmission Plot

## 40Mg : Monte Carlo Transmission Plot

Continue

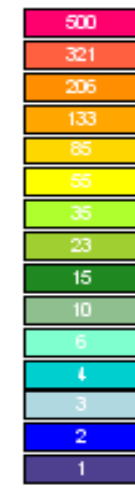
$^{48}\text{Ca}$  (140.0 MeV/u) + Be (795.44 mg/cm<sup>2</sup>) Transmitted Fragment  $^{40}\text{Mg}$  (Fragmentn); Optics Order: 4  
 dp/p=5.07% ; Wedges: Al (200 mg/cm<sup>2</sup>) Brho(Tm): 5.2293, 5.2293, 5.1342, 5.1342  
 "FP\_slits" - last block for MC calculation; no gate; Configuration: DDSWDDMMSSMM

after "FP\_slits": Y [mm]



Contnr  
 Sim 5.14e+03  
 Max 8  
 <X> 0.359  
 <Y> 0.0355  
 dx 5.21  
 dy 4.09  
 <XY> 2.2e-03

SUM  
 5.142e+03  
 CPU speed  
 0 pps  
 Eff: 26.9%



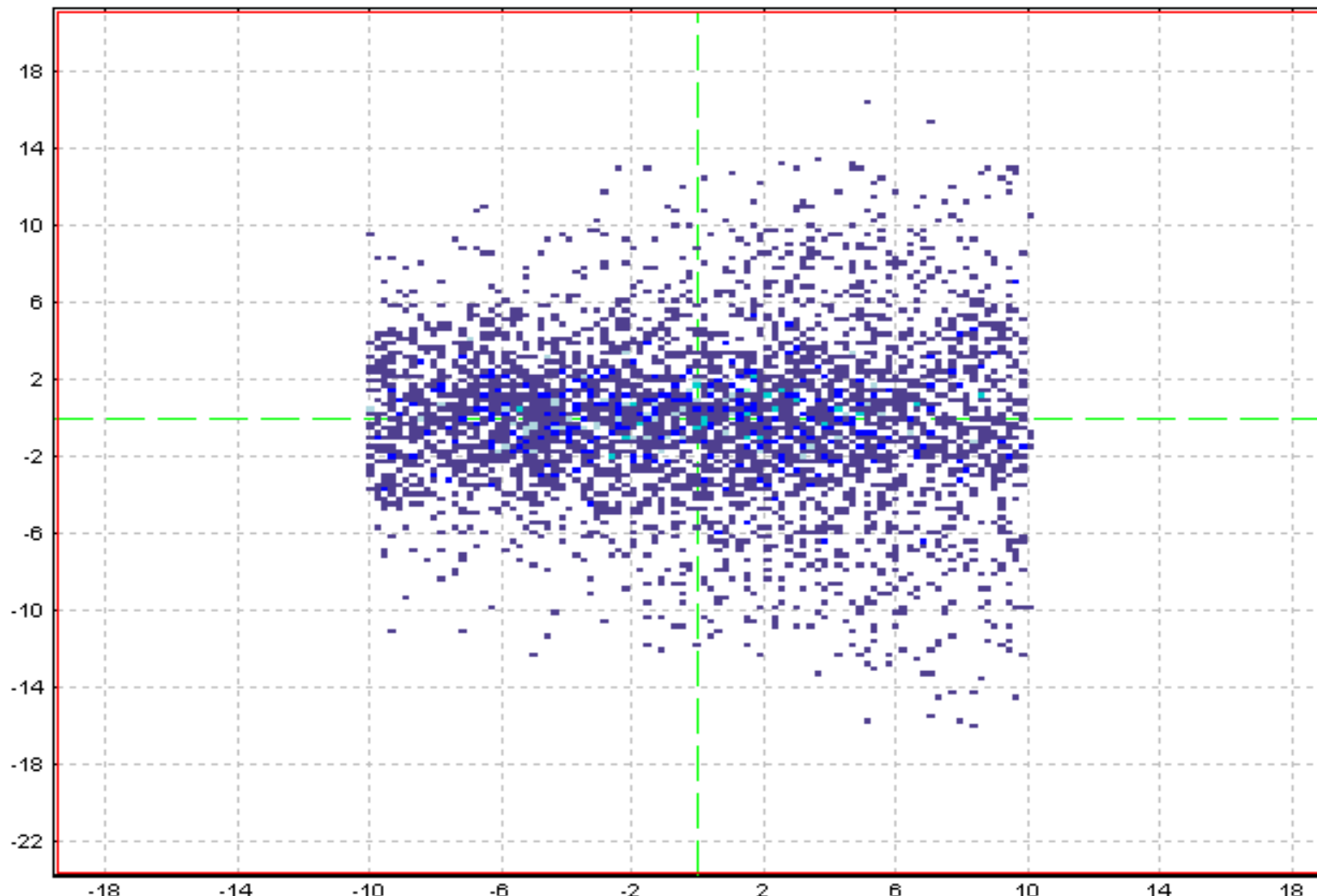
40Mg : Monte Carlo Transmission Plot

## 40Mg : Monte Carlo Transmission Plot

Continue

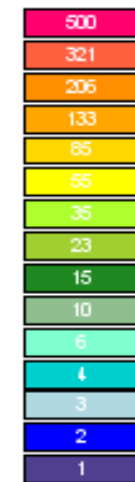
<sup>48</sup>Ca (140.0 MeV/u) + Be (795.44 mg/cm<sup>2</sup>) Transmitted Fragment <sup>40</sup>Mg (Fragmentn); Optics Order: 5  
 dp/p=5.07% ; Wedges: Al (200 mg/cm<sup>2</sup>) Brho(Tm) 5.2293, 5.2293, 5.1342, 5.1342  
 "FP\_slits" - last block for MC calculation; no gate; Configuration: DDSWDDMMSMM

after "FP\_slits": Y [mm]



Counter  
 Sim 4.22e+03  
 Max 7  
 <X> 0.163  
 <Y> -0.113  
 dx 5.29  
 dy 4.17  
 <XY> -4.4e-01

SUM  
 4.218e+03  
 CP U speed  
 0pps  
 Eff: 27.6%



after "FP\_slits": X [mm]

## High order optics

- MOCADI A1900 file for LISE++, as well as translator from MOCADI to LISE++
- The Optics dialog should be commissioned, as well Local <-> Global transformation.
- New utility for MC mode (Envelope plot to see transmission loss)
- New official LISE++ version 8.4. Include High orders.

## General

- Abrasion-Dissipation-Ablation (ADA)
- 64-bit operational system & LISE++
- MOTER
- Monte Carlo evaporation cascade to track “parents”
- Brho-method to measure half-lives

Thanks to  
Drs M.Portillo, M.Hausmann, D.Bazin,  
and Prof. B.Sherrill  
(NSCL/MSU)  
for help and fruitful discussions