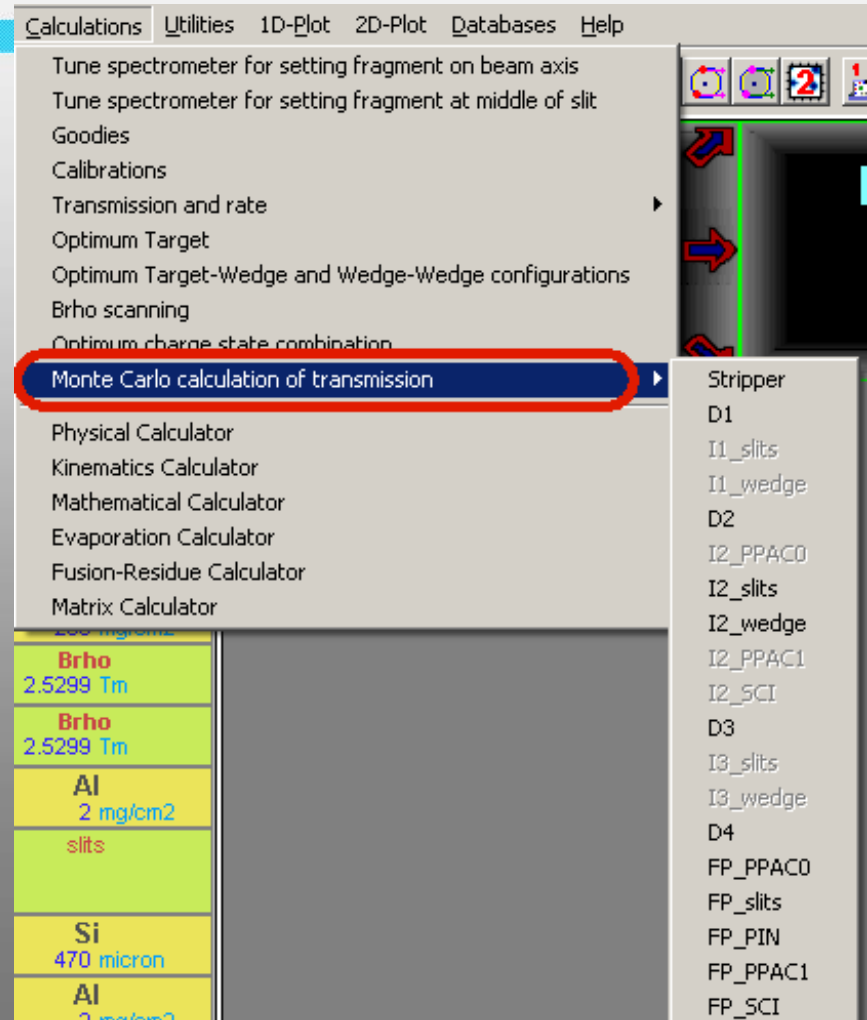


Monte Carlo calculation of fragment transmission

- Introduction. Access
- MC transmission dialog
- Options of MC transmission calculations
- Calculations of the “Length” value
- Angular acceptance
- Several different settings in one plot
- MC transmission and Reactions in wedge (FPinM)
- LISE++ blocks & MC transmission
- Selection gate

Monte Carlo calculation of fragment transmission



Projectile Fragmentation, Fusion-Evaporation, Fragment production in material are available for MC transmission. Use the Kinematics calculator for fission reactions .

Do not forget: primary beam is good tools to check optics!

Use 5x5 pixel for one event
(see the "Plot options" dialog)

MC transmission dialog

START

Monte Carlo calculation of fragment transmission

A	Element	Z	Table of Nuclides	
33	S	16		
Stable			← Z →	→ N →
			← ←	→ →

Charge states: 16+ D1

Reaction mechanism: Projectile Fragmentation

X-coordinate After BLOCK

FP_PIN

X mm
 X' (T) mrad
 Y mm
 Y' (P) mrad
 dP/P %

Energy MeV/u
 TKE MeV
 Momentum GeV/c
 Brho T*m
 Velocity cm/ns

Energy Loss MeV
 Time of flight ns
 Length m

Y-coordinate

FP_PIN

X mm
 X' (T) mrad
 Y mm
 Y' (P) mrad
 dP/P %

Energy MeV/u
 TKE MeV
 Momentum GeV/c
 Brho T*m
 Velocity cm/ns

Energy Loss MeV
 Time of flight ns
 Length m

Stripper <-- Start --> FP_PIN

FP_PIN <-- Stop --> Stripper

Cyclotron RF-signal

Gate: no gate

- Detector resolution is optionally taking into account for TOF, TKE and Energy Loss
- Only transmission value for angular acceptance and cutting by slits are shown (not Q-state value, loose due to reaction in material, etc)
- Transmission value corresponds for Last block used in the calculations (on this dialog for example the last block is "I2_wedge" block)

MC transmission options dialog

Time consumed

MC transmission options

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

Assume the reaction takes place at the middle of target

for Angular distributions

for Momentum distributions

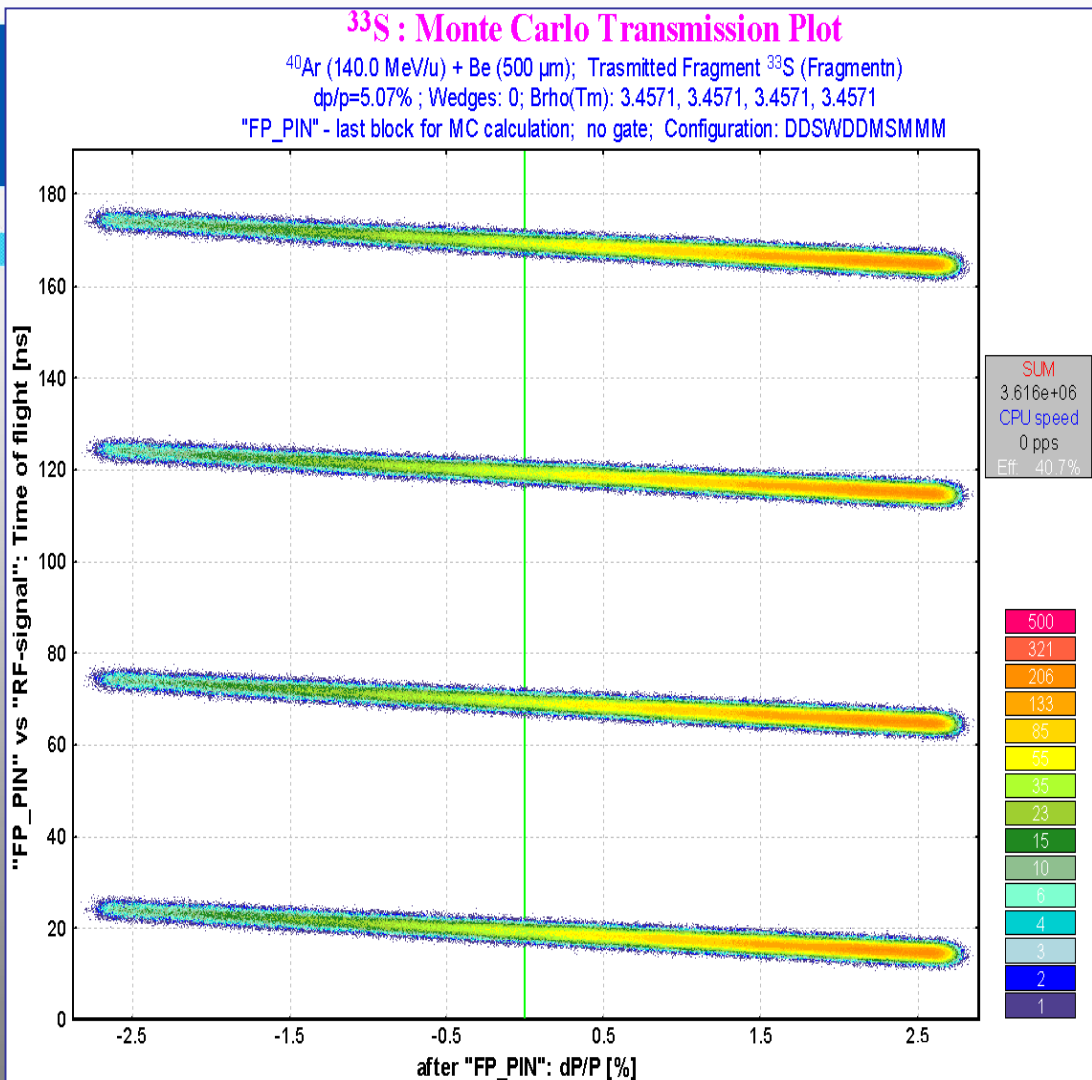
* these two distributions are correlated for fusion and fission reactions

Make default

OK Cancel Help

- Do not use lateral straggling if there are not gas targets or detectors. Otherwise it takes a lot of processor time
- Detector resolution is taking into account optionally for TOF, TKE and Energy Loss right now
- Assuming that the reaction takes place in the middle of target significantly improve calculation speed especially in the case of use of Convolution method

Plot options dialog modifications for MC transmission calculations



Plot Options

Default Dispersive Block for 'Brho'-plot (Tm)

Default Dispersive Block for 'Wedge'-plot (mm)

X space detector

X2 space detector

Y space detector

dE - detector

dE2 - detector

1st TKE detector (Range - detector)

Acquisition Start of TOF

Start of TOF calculated

Stop of TOF calculated

"Distribution" solution: Monte Carlo 2D-plot

Distribution compression 1

Pixels for one event 1 x 1

Monte Carlo calculation of transmission

Pixels for one event 5 x 5

RadioFrequency of Accelerator

Shift of TOF (delay) ns

Fraction of RF trigger

Default Resolutions for plots (sigma)

RF frequency ns

Time ns

X (horizontal space) mm

Y (vertical space) mm

Energetic

%

MeV

Default Detector Thickness defect (sigma)

%

micron at 0 deg.

TKE calibration

Optical matrix - D2

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

Matrices: Block (local) Global

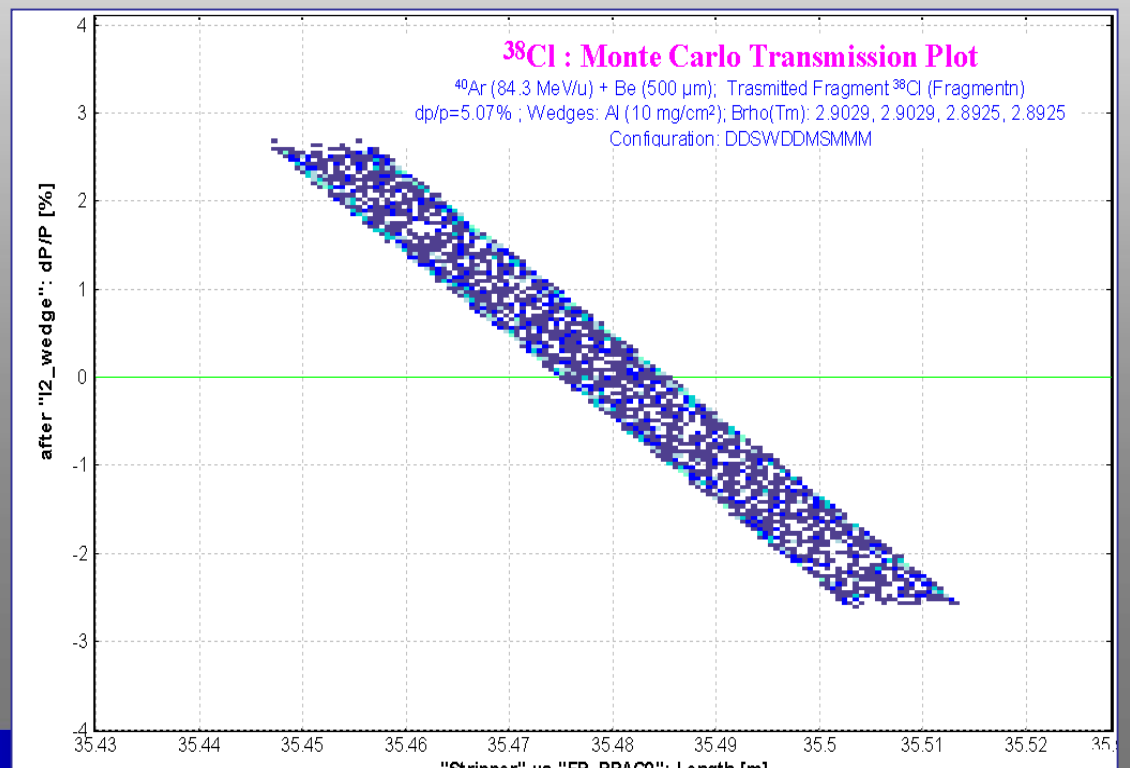
Dimension: mm cm

Block matrix							Global matrix						Beam	
1. X	-1.0323	-0.0212	0	0	0	-29.306	2.3553	0	0	0	0	-59.125	[mm]	6.364
2. T	0.0035	-0.9685	0	0	0	-0.1019	-1.0498	0.4246	0	0	0	-0.0009	[mrad]	3.152
3. Y	0	0	1.1474	-0.0017	0	0	0	0	0.8406	0	0	0	[mm]	0.841
4. F	0	0	4.1106	0.8651	0	0	0	0	6.2611	1.1902	0	0	[mrad]	11.396
5. L	-0.0209	2.8372	0	0	1	-2.4166	6.207	-2.51	0	0	1	-5.442	[mm]	21.155
6. D	0	0	0	0	0	1	0	0	0	0	0	1	[%]	0.1
	/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]	/[mm]	/[mrad]	/[mm]	/[mrad]	/[mm]	/[%]		
Det =	0.99946						1.00073							

Buttons:

5th row of optical matrices should be set correctly to calculate the "Length" value

New A1900 file contains the correct "dL" - row to calculate the "Length" value in MC mode.



Angular acceptance transmission

Preferences

Starting configuration at loading the program: A1900_2006.lcn

Starting options file at loading the program: A1900_2006.lopt

Display 1: Sum of reactions (pps)

Display 2: Total transmission (%)

Angular acceptance

Shape: rectangle

Method: projection on axis: (ax*ay)

Calculation threshold: 1.0e-20

Dimension of distribution (NP) recommended

Calculation	NP	Recommended
calculation WITHOUT charge states	32 <input type="button" value="v"/>	64
calculation WITH charge states	32 <input type="button" value="v"/>	32
wedge calculation	32 <input type="button" value="v"/>	16

Target optimization options

Plot options

Scheme options

Make default

Cross Section

Fit: Fit File

Calculate spectrometer settings using:

maximal mean

value of the momentum distribution

left peak right peak

Charge States

No Yes

Sound

3D-Balls Animation

Navigation map

Spectrometer scheme

Show transmission calculation time

Hold angles of an inclination of a target and a stripper together

Primary beam scattering in a target

Charge State Optimization Debugging Mode

Distribution Debugging Mode (file 'distrib.txt')

Check LIZ-file consistency (Configurations)

Check LIZ-file consistency (Options)

In the “Preference” dialog it is possible to choose an angular acceptance method to be used in the code.

Method “Projection on axis” corresponds to the Rectangle shape.

Method “Jacobian” corresponds to the Ellipse shape

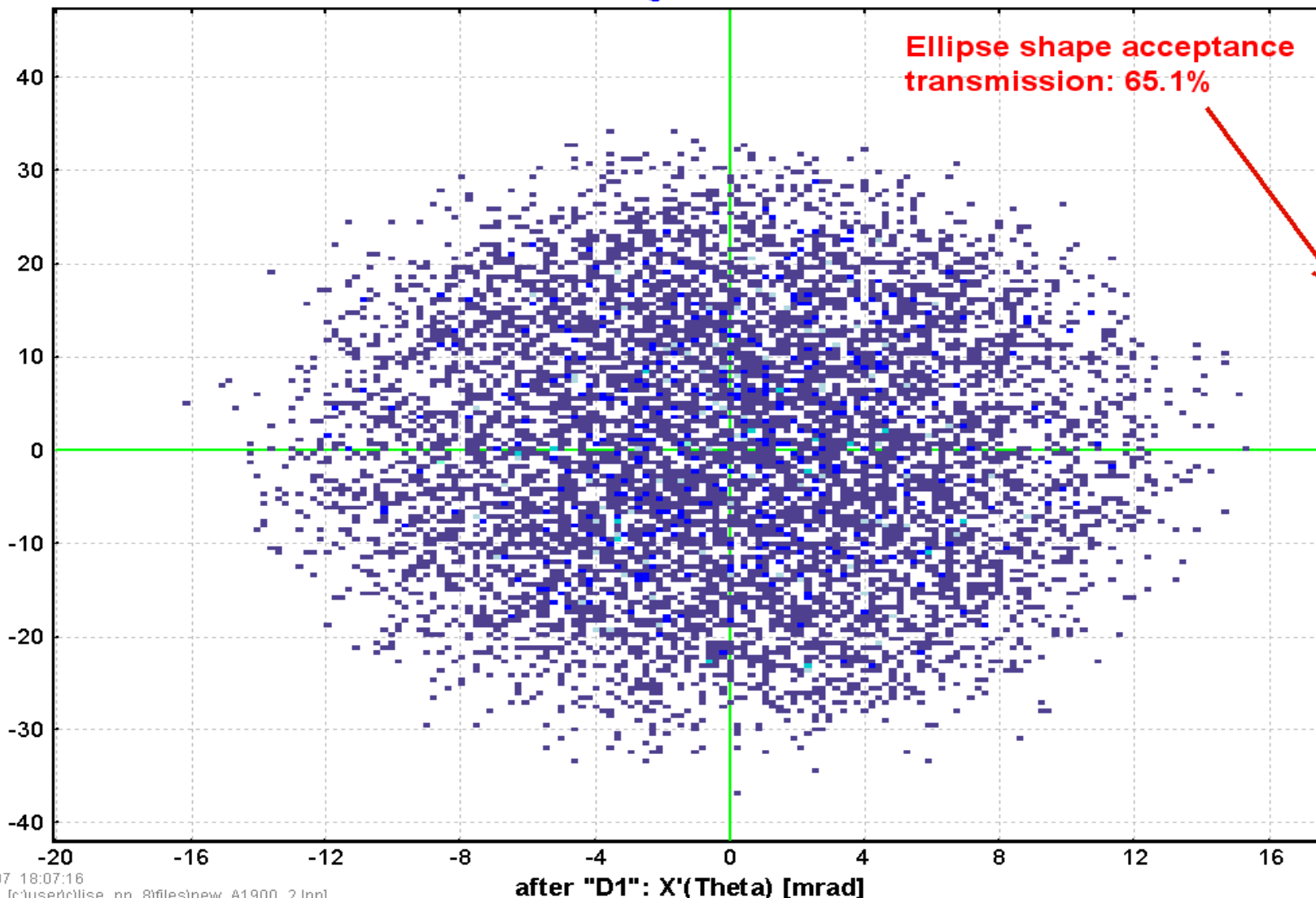
Angular acceptance transmission: Ellipse shape

^{38}Cl : Monte Carlo Transmission Plot

[Continue](#)

^{40}Ar (84.3 MeV/u) + Be (500 μm); Transmitted Fragment ^{38}Cl (Fragmentn)
 dp/p=5.07% ; Wedges: Al (10 mg/cm²); Brho(Tm): 2.9029, 2.9029, 2.8925, 2.8925
 Configuration: DDSWDDMSMMM

after "D1": Y'(Phi) [mrad]



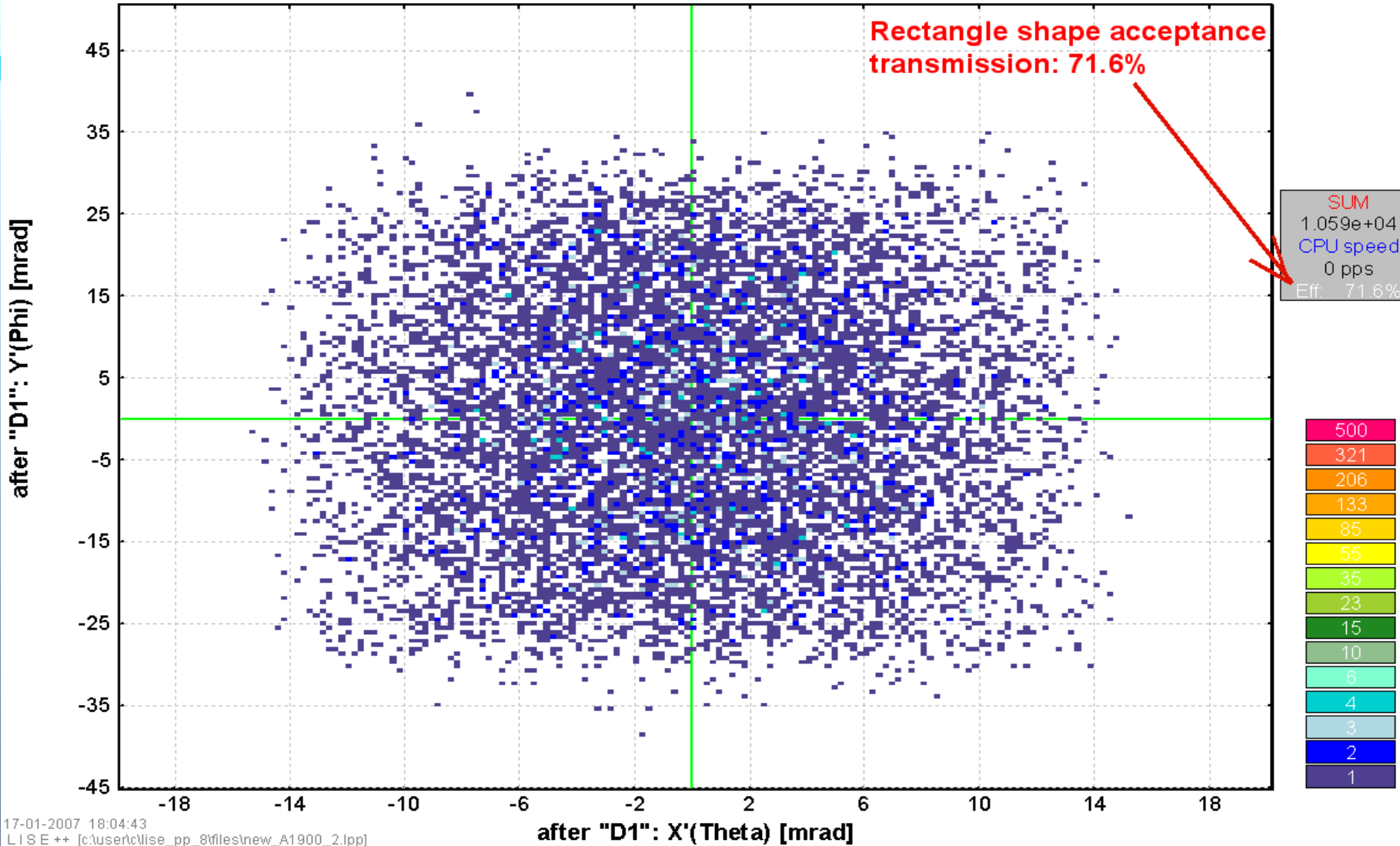
SUM
 8.221e+03
 CPU speed
 0 pps
 Eff. 65.1%

Angular acceptance transmission: Rectangle shape

Continue

^{38}Cl : Monte Carlo Transmission Plot

^{40}Ar (84.3 MeV/u) + Be (500 μm); Transmitted Fragment ^{38}Cl (Fragmentn)
 dp/p=5.07% ; Wedges: Al (10 mg/cm²); Brho(Tm): 2.9029, 2.9029, 2.8925, 2.8925
 Configuration: DDSWDDMSMMM



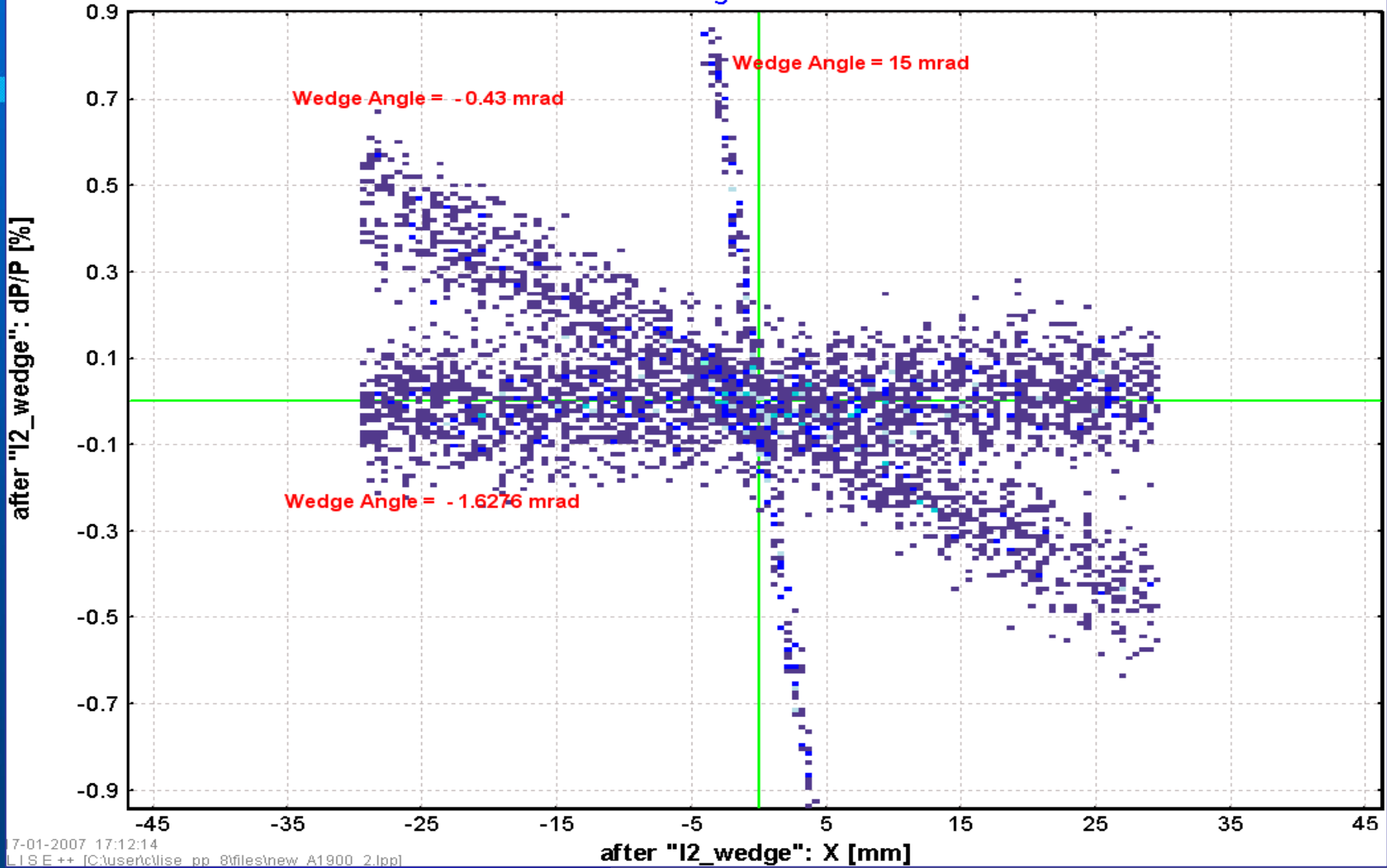
Several different settings in one plot

The screenshot displays the LISE++ software interface. On the left, a panel lists various components like Target (Be), Strippers (D1-D4), and Fragmentation (FP) stages. The central window is titled "Monte Carlo calculation of fragment transmission" and contains settings for Element (Cl), Z (17), and various physical parameters. A "38Cl : Monte Carlo Transmission Plot" is shown, displaying a scatter plot of Y(P) vs X(Theta) for 38Cl. A color scale on the right indicates event counts per pixel. A dialog box for "I2_wedge" is open, showing material properties for Al. Red arrows and text annotations highlight key steps: "1. Run MC calculation", "2. Stop MC acquisition do not close the plot", "3. choose a dialog to modify the configuration", and "4. click 'Continue' to start acquisition with new settings".

The Efficiency value on plot is average value of all accumulated events for all settings

^{38}Cl : Monte Carlo Transmission Plot

^{40}Ar (84.3 MeV/u) + Be (500 μm), C (500 μm); Transmitted Fragment ^{38}Cl (Fragmentn)
 $dp/p=1.00\%$; Wedges: Al (200 mg/cm^2); Brho(Tm): 2.7747, 2.7747, 2.5299, 2.5299
 Configuration: DDSWDDMSMMM



- In the case of FPinM option (Secondary target) the code calculates values beginning from this fragment production block and downstream.
- Dispersion method should be used for FRinM
- If the FPinM database of parent nuclei is empty then the code proposes to calculate it to use the final "Dispersive E-X" matrix as start point

Projectile $^{40}\text{Ar}^{18+}$
140 MeV/u 1 pnA

Fragment $^{32}\text{S}^{16+}$

Target Be
500 micron

Stripper

D1 Brho 3.4570 Tm

D2 Brho 3.4570 Tm

I2_slits slits
-29.5 | +29.5

I2_wedge Al 250 micron

D3 Brho 3.4226 Tm

Monte Carlo calculation of fragment transmission

A: 32, Element: S, Z: 16

Table of Nuclides

Charge states: 16+ D1

Reaction mechanism: Secondary Target ~1

X-coordinate After BLOCK: I2_wedge

Y-coordinate After BLOCK: FP_slits

Options: X, X' (T), Y, Y' (P), dP/P, Energy, TKE, Momentum, Brho, Velocity

Fragment production in materials

?"Dispersion" method should be set for fragment production in material. Do you want to correct that?

Yes No

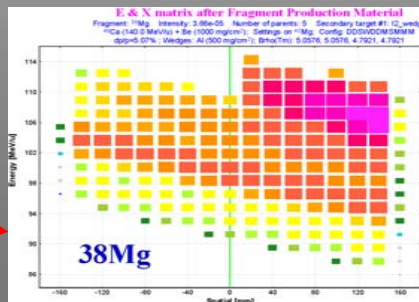
Options of Fragment Production in Material (wedge)

	ACCURATE	FAST													
Dimension of distributions used for fragment production calculations in Material or Wedge	16	8													
Use fragments produced in Material (Wedge) for fragment production in the following Material or Wedge with the "Calculate fragment production" option turned on	Yes	No													
Method to calculate kinematics of fragment produced in Material or Wedge	"Distribution"	"Gaussian"	"Dispersion" (special case)												
Rate Threshold for the parent-daughter link	1e-5 pps	set all to "Accurate"	set all to "Fast"												
Show statistics of fragment production in Materials (Wedges)	<table border="1"> <tr> <td colspan="2">Calculation Rectangle of fragments produced in Material * DAUGHTER region *</td> <td>Z</td> <td>N</td> </tr> <tr> <td>first corner =></td> <td>TH</td> <td>min</td> <td>1 0</td> </tr> <tr> <td>second corner =></td> <td>40Ar</td> <td>max</td> <td>18 22</td> </tr> </table>			Calculation Rectangle of fragments produced in Material * DAUGHTER region *		Z	N	first corner =>	TH	min	1 0	second corner =>	40Ar	max	18 22
Calculation Rectangle of fragments produced in Material * DAUGHTER region *		Z	N												
first corner =>	TH	min	1 0												
second corner =>	40Ar	max	18 22												
Make default	<input type="checkbox"/>														
Ok	Cancel														

No yield for setting fragment!

For fragment production in material preliminary it is necessary to calculate parent nucleus intensities. Calculate them now?

Yes No



See details for FPinM
http://groups.nslc.msu.edu/lise/8_0/secondary_targets.pdf

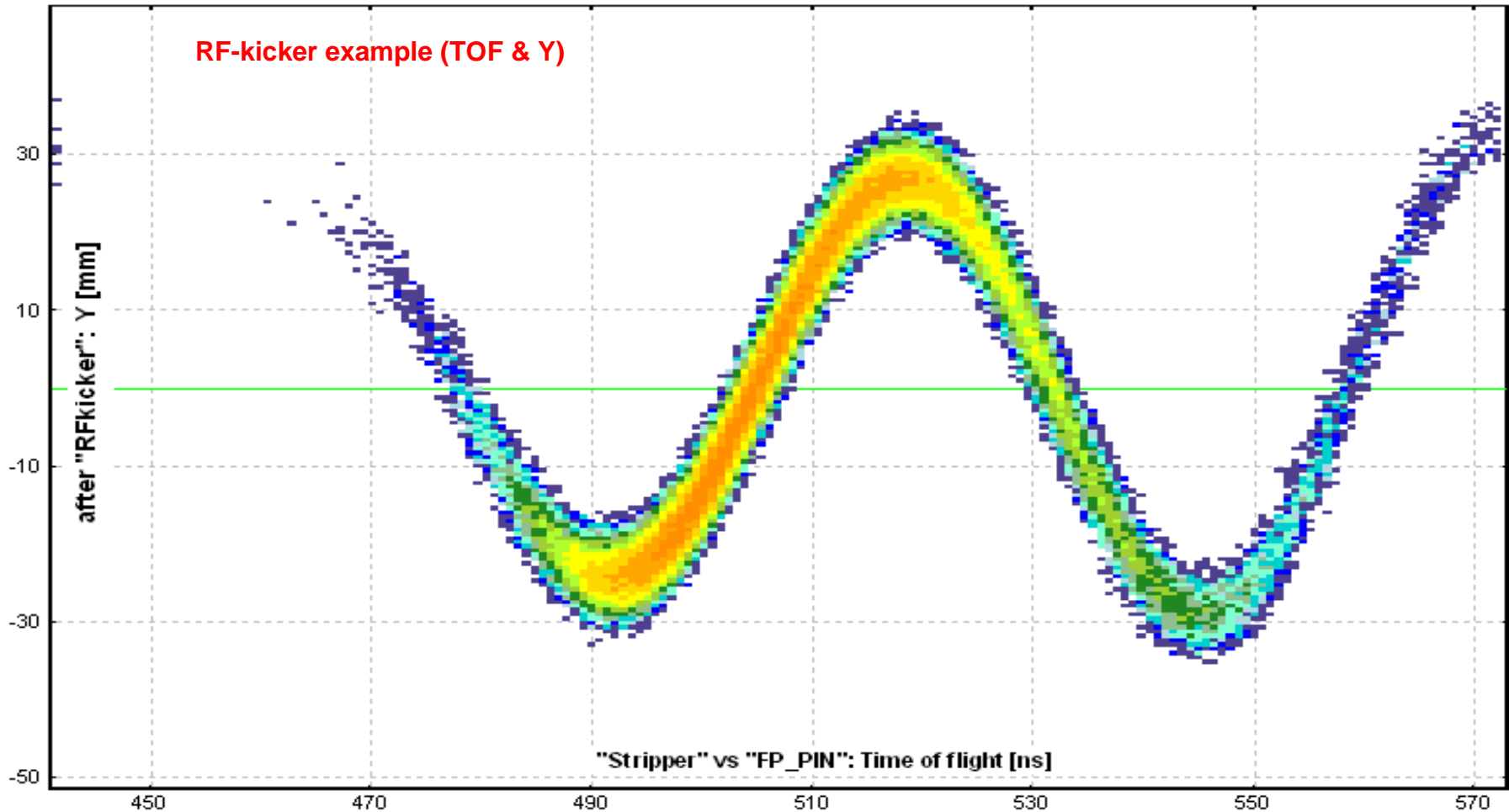
LISE++ blocks & MC transmission

All LISE++ blocks were adapted for MC transmission including Gas-filled separator, Wien-filter, and RF-kicker. All remarks will be appreciated.

^{100}Sn : Monte Carlo Transmission Plot

^{124}Xe (140.0 MeV/u) + Be (500 mg/cm²); Transmitted Fragment $^{100}\text{Sn}^{50+50+50+50+50+}$ (Fragmentn)
 dp/p=100.00% ; Wedges: 0; Brho(Tm): 2.5425, 2.5425, 2.5425, 2.5425

"FP_PIN" - last block for MC calculation; no gate; Configuration: DDSWDDMSSSKMMMM



Selection Gate

Monte Carlo calculation of fragment transmission

A: 100 Element: Sn Z: 50

Charge states: 50+ D1

Reaction mechanism: Projectile Fragmentation

MC transmission options

"Distribution" calculation

Monte Carlo calculation

Quit

X-coordinate: RFkicker

Y-coordinate: RFkicker

Gate: "AND" [-10, 10] < Y [mm] > after FP_PIN

Settings

Gate for Monte Carlo calculation transmission

Status (Condition): "AND"

Gate: v1 = -10, v2 = 10

Coordinate: FP_PIN

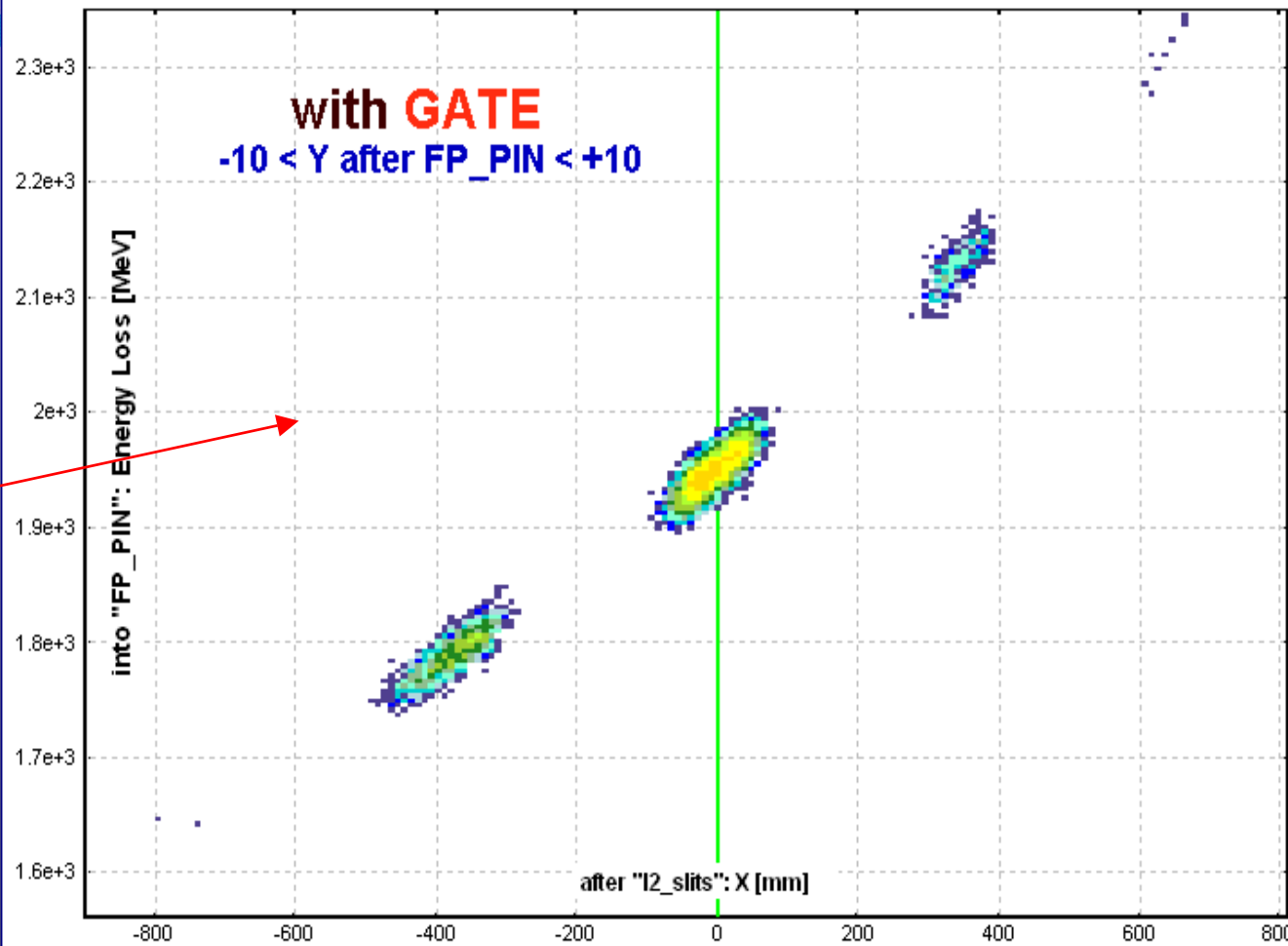
OK

Cancel

Selection Gate

¹⁰⁰Sn : Monte Carlo Transmission Plot

¹²⁴Xe (140.0 MeV/u) + Be (500 mg/cm²); Transmitted Fragment ¹⁰⁰Sn⁵⁰⁺ ⁵⁰⁺ ⁵⁰⁺ ⁵⁰⁺ ⁵⁰⁺ (Fragmentn)
 dp/p=100.00% ; Wedges: 0; Brho(Tm): 2.5425, 2.5425, 2.5425, 2.5425
 "FP_PIN" - last block for MC calculation; Gate: "AND" (Y [mm]); Configuration: DDSWDDMSSSKMMMM



X-coordinate
After BLOCK

I2_slits

- X mm
- X' (T) mrad
- Y mm
- Y' (P) mrad
- dP/P %
- Energy MeV/u
- TKE MeV
- Momentum GeV/c
- Brho T*m
- Velocity cm/ns
- Energy Loss MeV
- Time of flight ns
- Length m

Stripper <- Start -> Stripper

Stripper <- Stop -> FP_PPACD

Y-coordinate
Into block

FP_PIN

- X mm
- X' (T) mrad
- Y mm
- Y' (P) mrad
- dP/P %
- Energy MeV/u
- TKE MeV
- Momentum GeV/c
- Brho T*m
- Velocity cm/ns
- Energy Loss MeV
- Time of flight ns
- Length m

Gate

"AND" [-10, 10] Settings

< Y [mm] > after FP_PIN