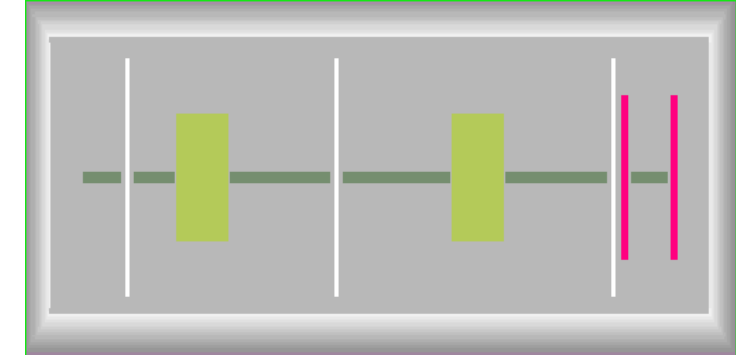
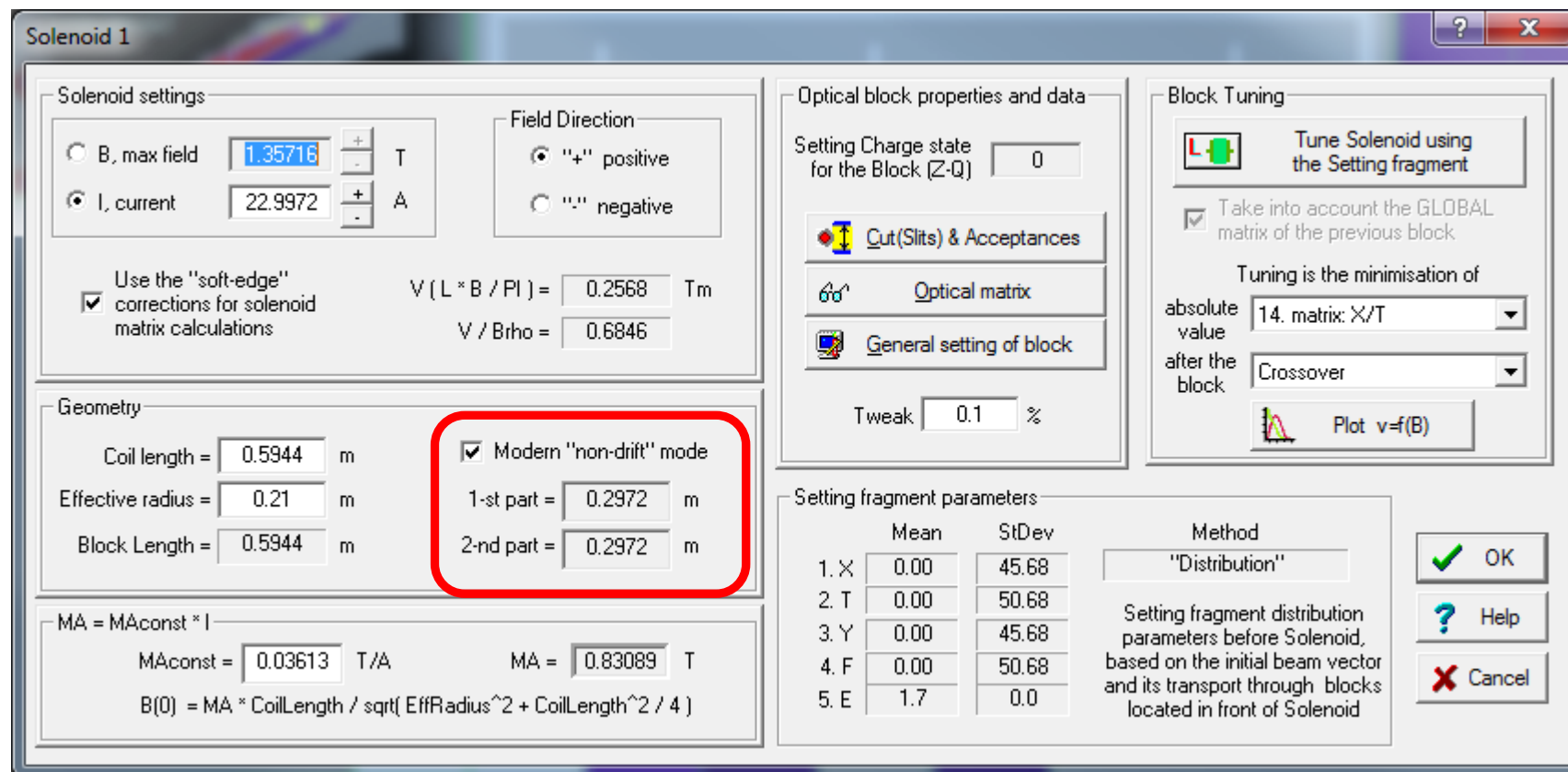


v.9.10.361  
from 10/14/16

v.9.10.377  
from 11/07/16  
update

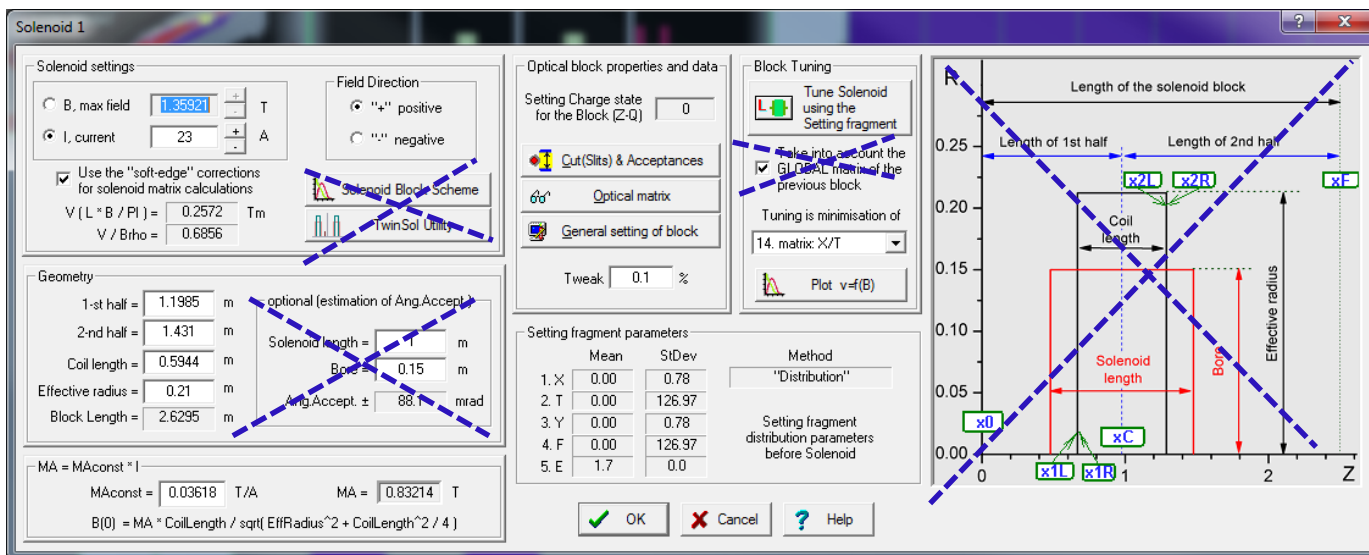
1. “The “Solenoid” block : no more drifts
2. “The “Solenoid” block dialog modification
3. TwinSol configuration in LISE++ package
4. TwinSol utility update
5. Two peaks at Envelopes
6. Are there two peaks with Twinsol the utility?





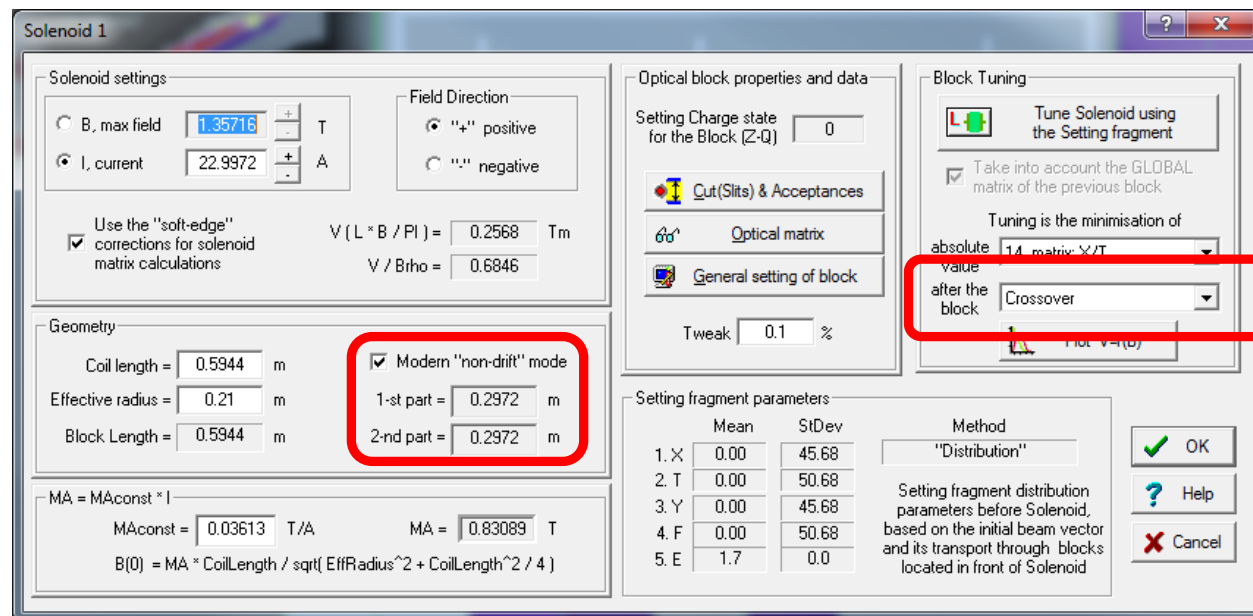
In the previous version it was impossible to insert an additional block (slits, material and so on) between solenoid drift and solenoid core itself., or to set their apertures independently

# “The “Solenoid” block dialog modification



“Old”  
v.9.9

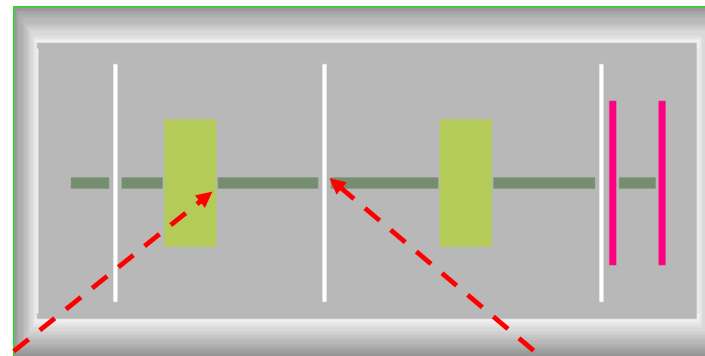
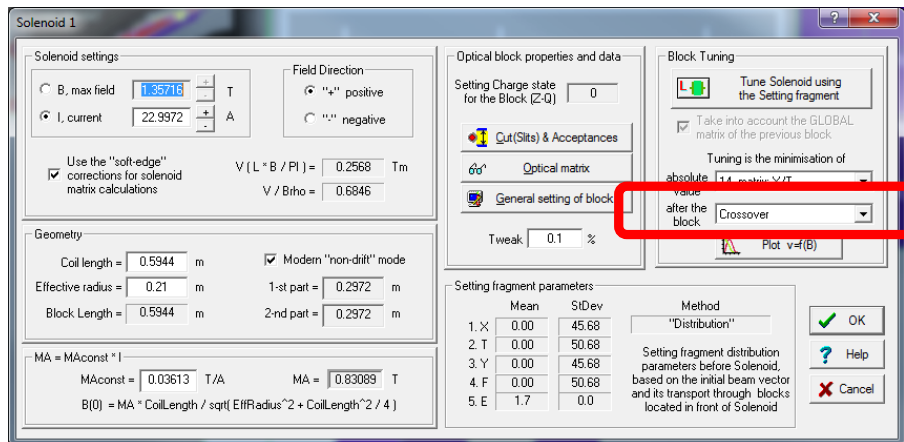
The “old” solenoid block dialog was based on classical solenoid properties from the TwinSol utility. Solenoid tuning was done with a matrix after the solenoid, what assumed drift existence in the solenoid block.



“New”  
v.9.10.361

The new” solenoid block allows to select a block which map matrix will be used for tuning.

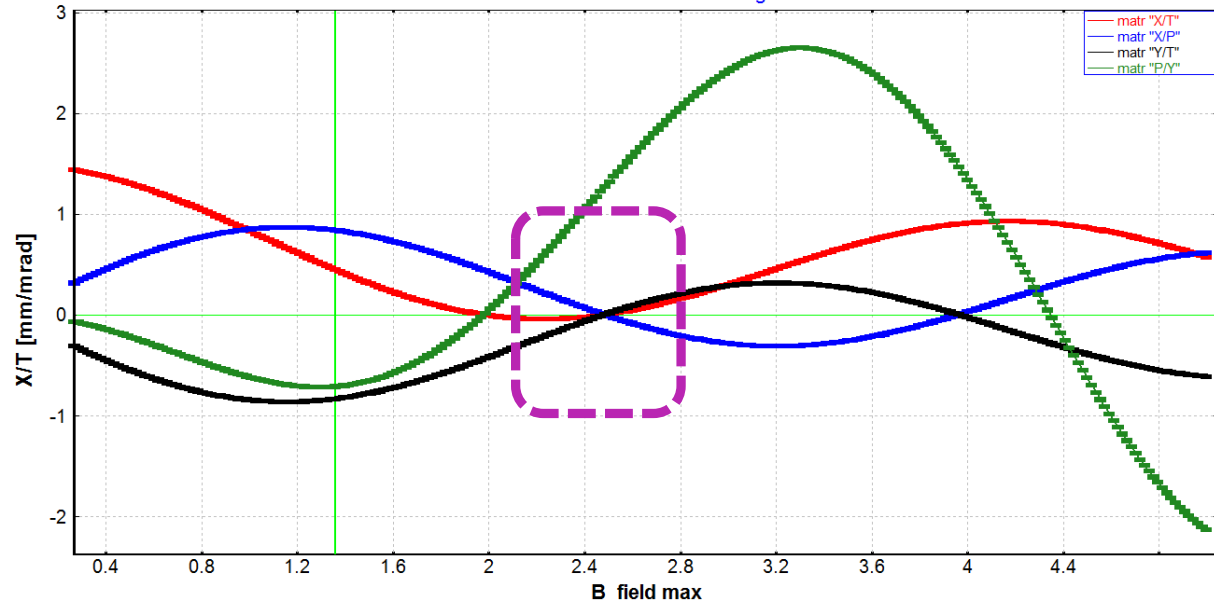
The new” solenoid block allows to select a block which map matrix will be used for tuning.



## Solenoid block tuning: X/T [mm/mrad]

Tuning Parameter is <Matrix coefficients>: "14. matrix: X/T". Tuning is after the "Solenoid 1" block  
 $^4\text{He}^{2+}$  (E=1.69 MeV/u or Ptrans=0.112 GeV/c) Emittance: 45.66, 50.66, 45.66, 50.66 mit.Ray: 0, 0, 0

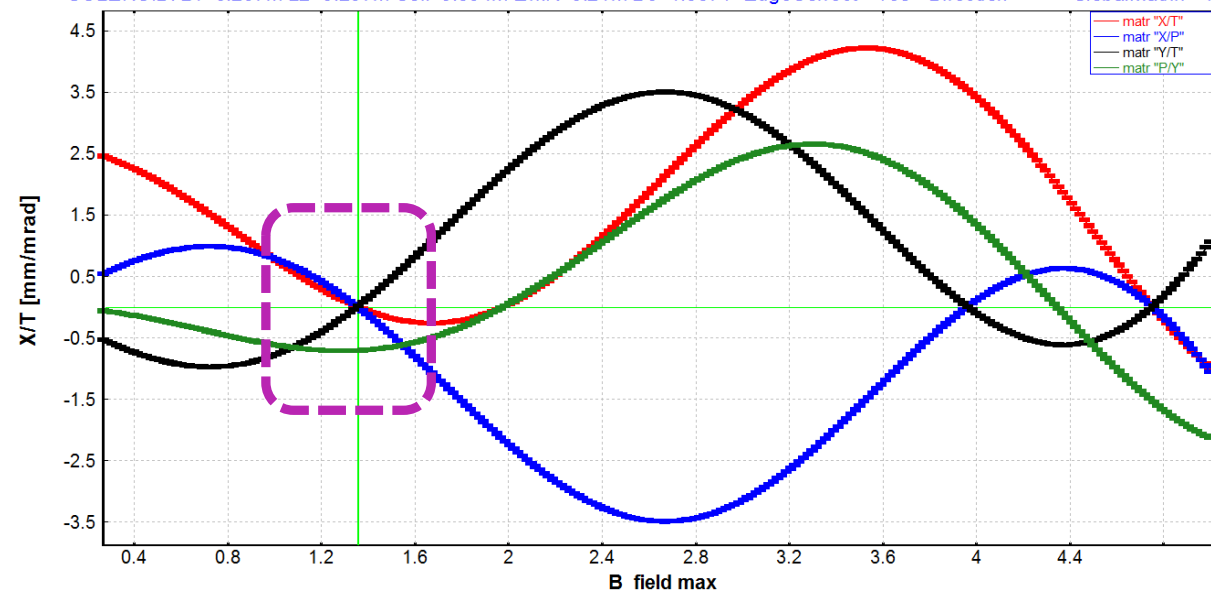
SOLENOID: L1=0.297m L2=0.297m Coil=0.594m Eff.R=0.21m B0=1.357T EdgeCorrect="Yes" Direction="+" GlobalMatrix="Ye



## Solenoid block tuning: X/T [mm/mrad]

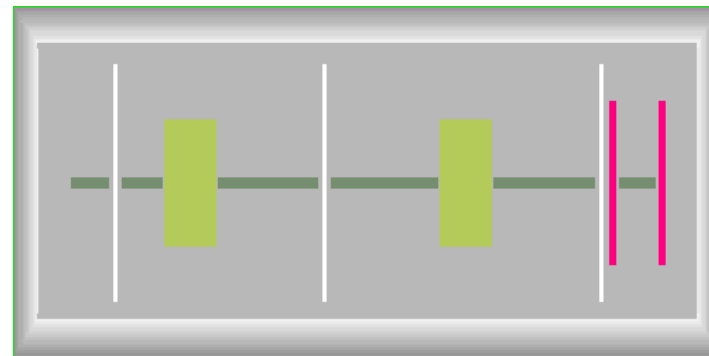
Tuning Parameter is <Matrix coefficients>: "14. matrix: X/T". Tuning is after the "Crossover" block  
 $^4\text{He}^{2+}$  (E=1.69 MeV/u or Ptrans=0.112 GeV/c) Emittance: 45.66, 50.66, 45.66, 50.66 mit.Ray: 0, 0, 0

SOLENOID: L1=0.297m L2=0.297m Coil=0.594m Eff.R=0.21m B0=1.357T EdgeCorrect="Yes" Direction="+" GlobalMatrix="Ye



## TwinSol configuration in LISE<sup>++</sup> package

Name	Ext	Size	Date
[.]	<DIR>	10/14/2016	
FMA	lcn	106,856	09/14/2015
one_dipole	lcn	5,537	08/25/2002
one_drift	lcn	6,029	08/25/2002
PRISMA	lcn	57,265	11/19/2014
RESOLUT_1gap	lcn	60,568	02/28/2013
RESOLUT_3gap	lcn	67,031	02/28/2013
<b>TwinSol</b>	<b>lcn</b>	<b>55,171</b>	<b>10/14/2016</b>



## TwinSol working file in LISE<sup>++</sup> package

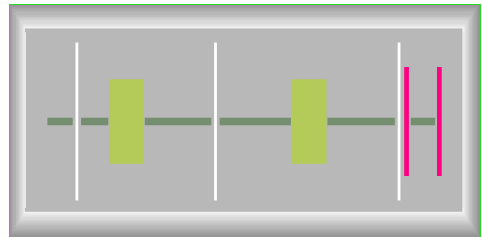
Name	Ext	Size	Date
[.]	<DIR>	10/14/2016	
[afission]	<DIR>	04/06/2015	
[Dubna]	<DIR>	06/02/2016	
[GANIL]	<DIR>	11/30/2015	
[GSI-SFRS]	<DIR>	04/06/2015	
[NSCL]	<DIR>	05/24/2016	
[RESOLUT]	<DIR>	04/06/2015	
[RIKEN]	<DIR>	04/06/2015	
[SECAR]	<DIR>	09/16/2015	
[TAMU]	<DIR>	04/06/2015	
[TRIUMF]	<DIR>	06/02/2016	
Input MC rays	inrays	27,475	04/11/2013
Coulomb Fission Example	lpp	116,538	12/29/2014
de_e_test	lpp	64,174	12/29/2014
FITconstraints	lpp	28,118	05/06/2015
FMA_32S_58Ni	lpp	173,157	06/07/2016
PRISMA	lpp	82,331	11/19/2014
<b>TwinSol</b>	<b>lpp</b>	<b>75,327</b>	<b>10/14/2016</b>

Aperture and slits should set correctly!!!  
Angular acceptance should be deduced in order to use this configuration properly in the "Distribution" mode

Block	Given Name	Start(m)	Length(m)	B0(kG)/U	Br(Tm)cor/*real	DriftM/*Angle	Rapp(cm)/R(m)	Leff(m)/Ldip(m)	2nd order	CalcMatr/*Z-Q	AngAcc.Apps.Slits	COSY	SE
d	drift	Drift 1	0.000	0.4325		standard					-- -- --	-	e
S	_slits_	Slit 1	0.432	0.0000		SLITS					-- HV HV	-	e
d	drift	before Sol1	0.432	0.4688		standard					-- HV --	-	e
L	Solenoid	Solenoid 1	0.901	0.5944	1.3572 T	0.3751	Eff 0.210	Coil 0.594	-	* 0	-- HV --	-	e
d	drift	after Sol1	1.496	1.1338		standard					-- HV --	-	e
S	_slits_	Crossover	2.630	0.0000		SLITS					-- HV HV	-	e
d	drift	bef Sol2	2.630	1.2078		standard					-- HV --	-	e
L	Solenoid	Solenoid 2	3.837	0.5944	1.2691 T	0.3751	Eff 0.210	Coil 0.594	-	* 0	-- HV --	-	e
d	drift	after Sol2	4.432	1.1398		standard					-- HV --	-	e
S	_slits_	Slits 2	5.572	0.0000		SLITS					-- HV HV	-	e
d	drift	last	5.572	0.4220		standard					-- -- --	-	e

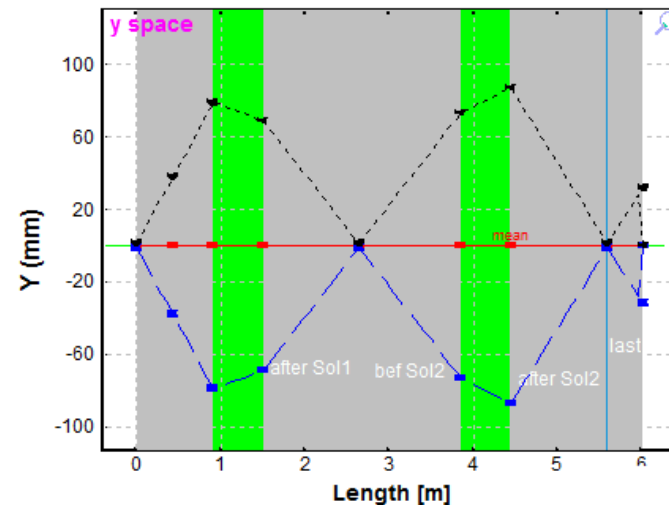
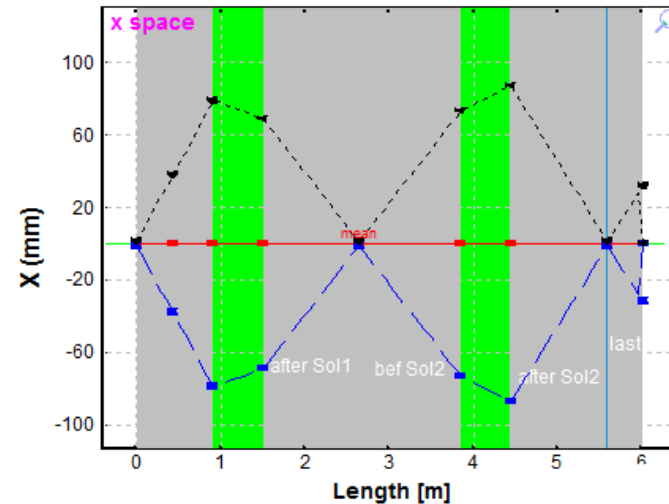
## TwinSol working file in LISE++ package

Name	Ext	Size	Date
[...]	<DIR>		10/14/2016
[afission]	<DIR>		04/06/2015
[Dubna]	<DIR>		06/02/2016
[GANIL]	<DIR>		11/30/2015
[GSI-SFRS]	<DIR>		04/06/2015
[NSCL]	<DIR>		05/24/2016
[RESOLUT]	<DIR>		04/06/2015
[RIKEN]	<DIR>		04/06/2015
[SECAR]	<DIR>		09/16/2015
[TAMU]	<DIR>		04/06/2015
[TRIUMF]	<DIR>		06/02/2016
Input MC rays	inrays	27,475	04/11/2013
Coulomb FissionExample	lpp	116,538	12/29/2014
de_e_test	lpp	64,174	12/29/2014
FITconstraints	lpp	28,118	05/06/2015
FMA_32S_58Ni	lpp	173,157	06/07/2016
PRIMA	lpp	82,881	11/18/2014
<b>TwinSol</b>	lpp	75,327	10/14/2016



## Analytical solution

node: U=3.4e+03 KV; Settings on  $^4\text{He}$ ; Con  
dp/p=100.00%

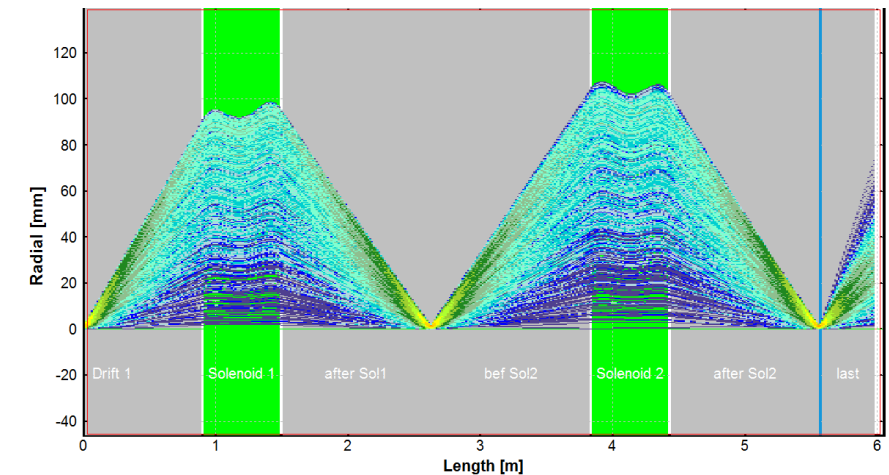
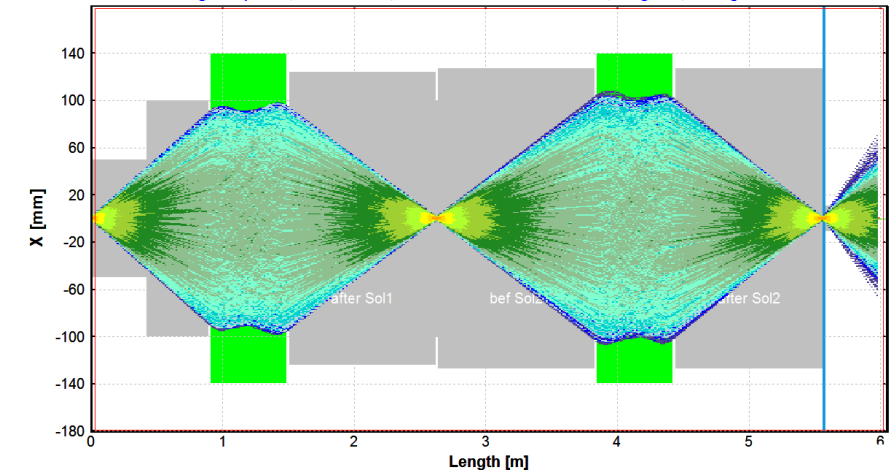


## Monte Carlo solution

### $^4\text{He}$ : MC Transmission Plot - Envelope (only passed)

$^4\text{He}$  (1.69 MeV/u) + ; Transmitted Fragment  $^4\text{He}$  (beam); Optics Order: 1  
dp/p=100.00%

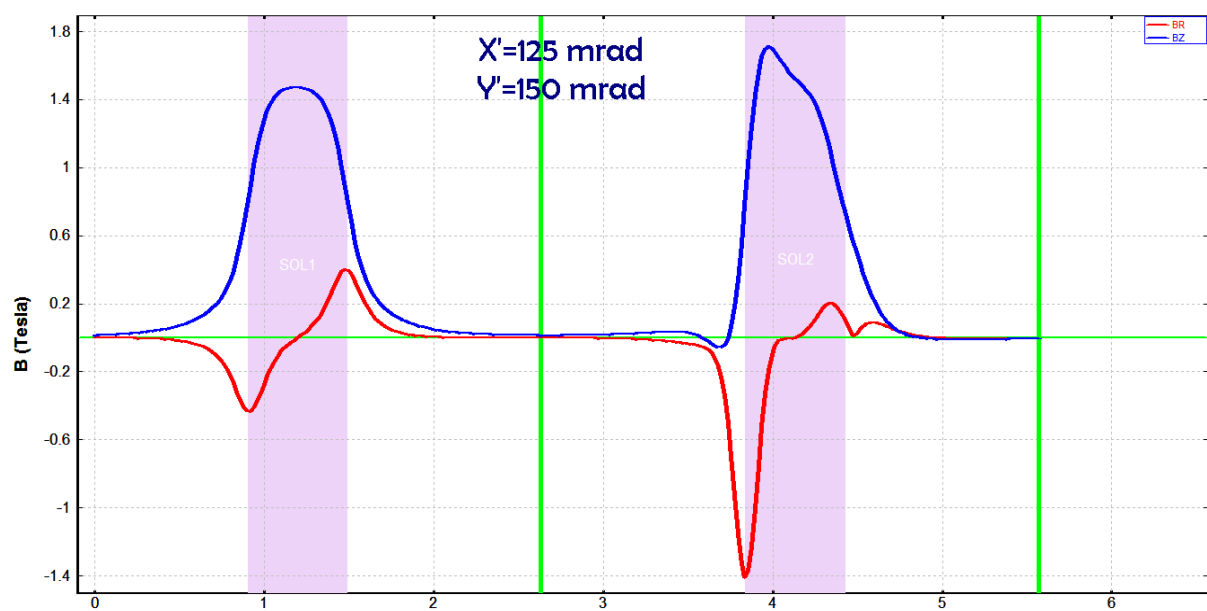
AngAccept ON; Bounds: Off; "last" - last block for MC calc; no gates; Config: SSSLSSLSMSM



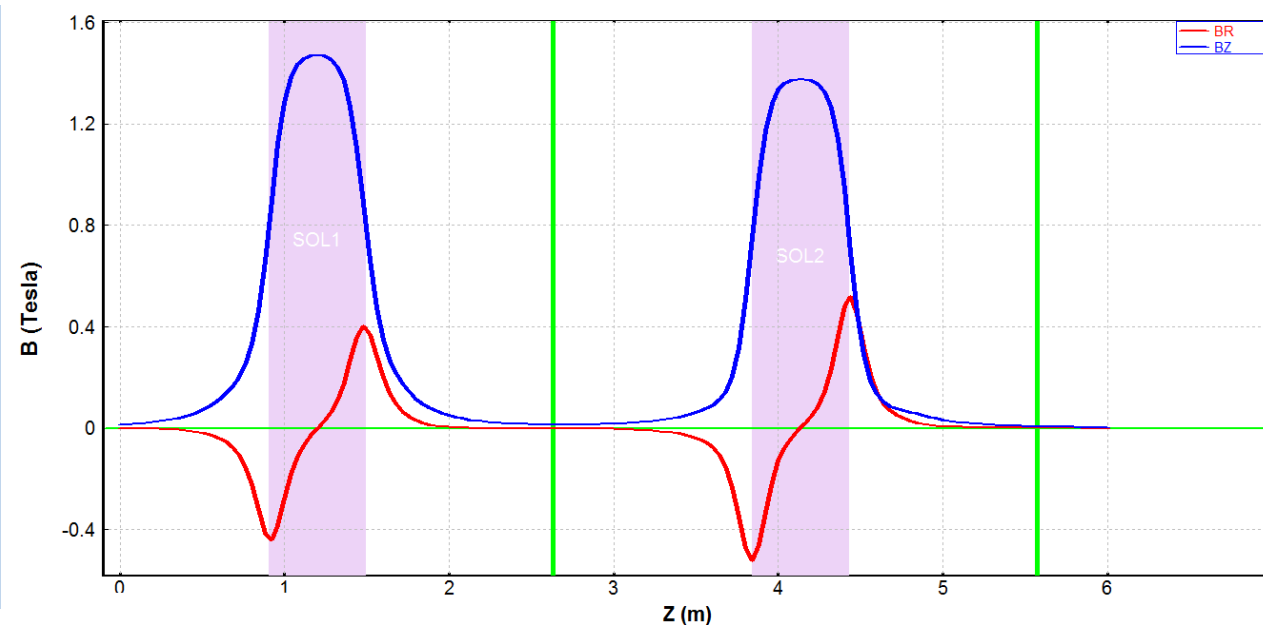


## Twin Sol: B-field (@ ray trajectory)

$^4\text{He}^{2+}$  (E=1.69 MeV/u or Ptrans=0.112 GeV/c) Emittance:1.5,125,1.5,150 Init.Ray:1.5,125,1.5,150  
1st SOL: L1=1.2m L2=1.4m Coil=0.6m B0=1.359T Efield=No; 2nd SOL: L1=1.5m L2=1.4m Coil=0.6m B0=1.271T Efield=No



**v.9.10.354**  
**Should be corrected!**

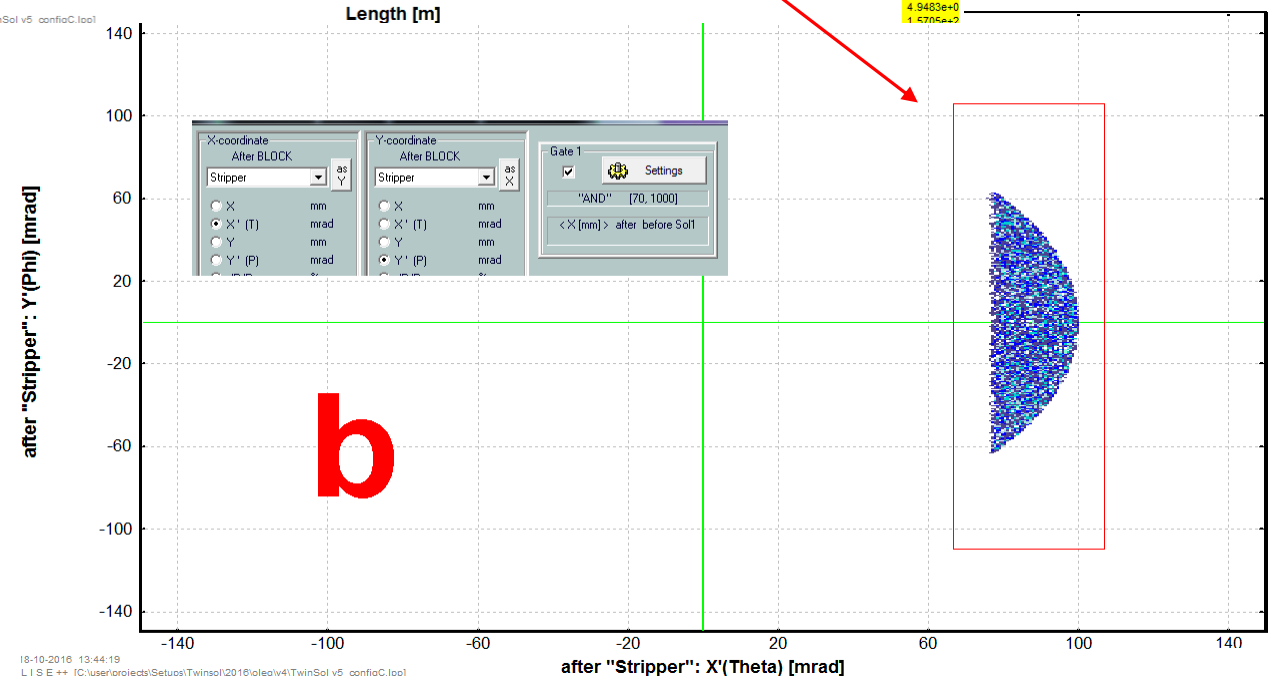
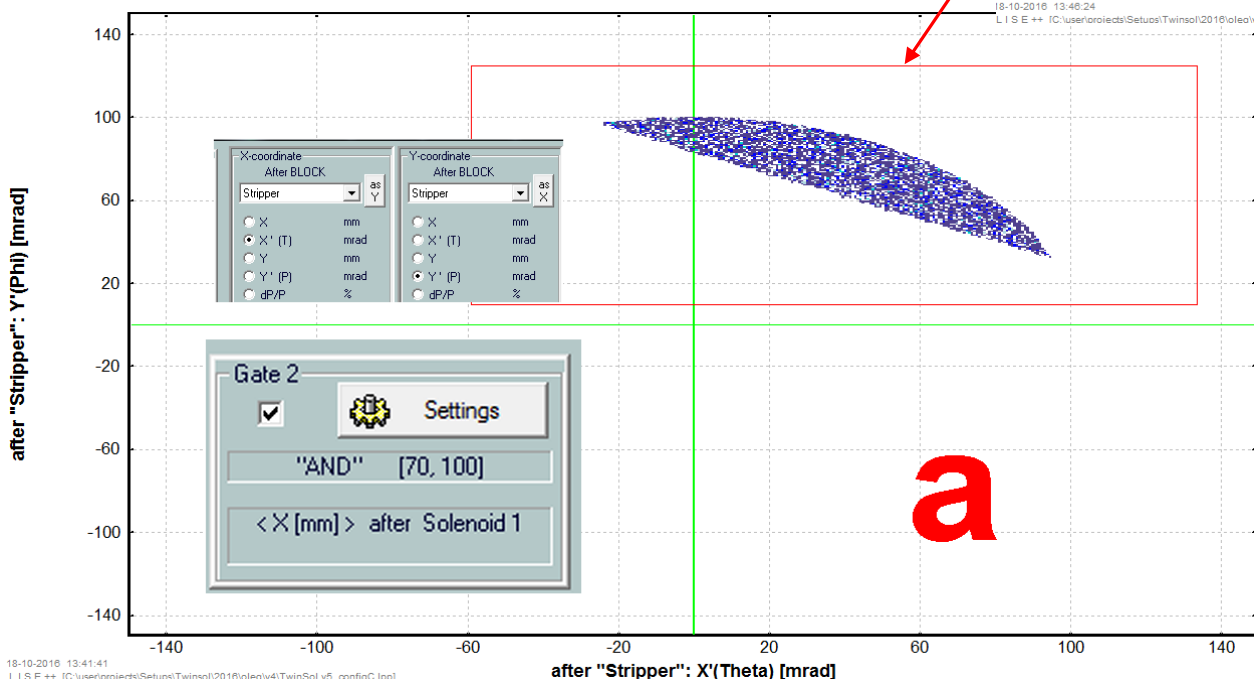
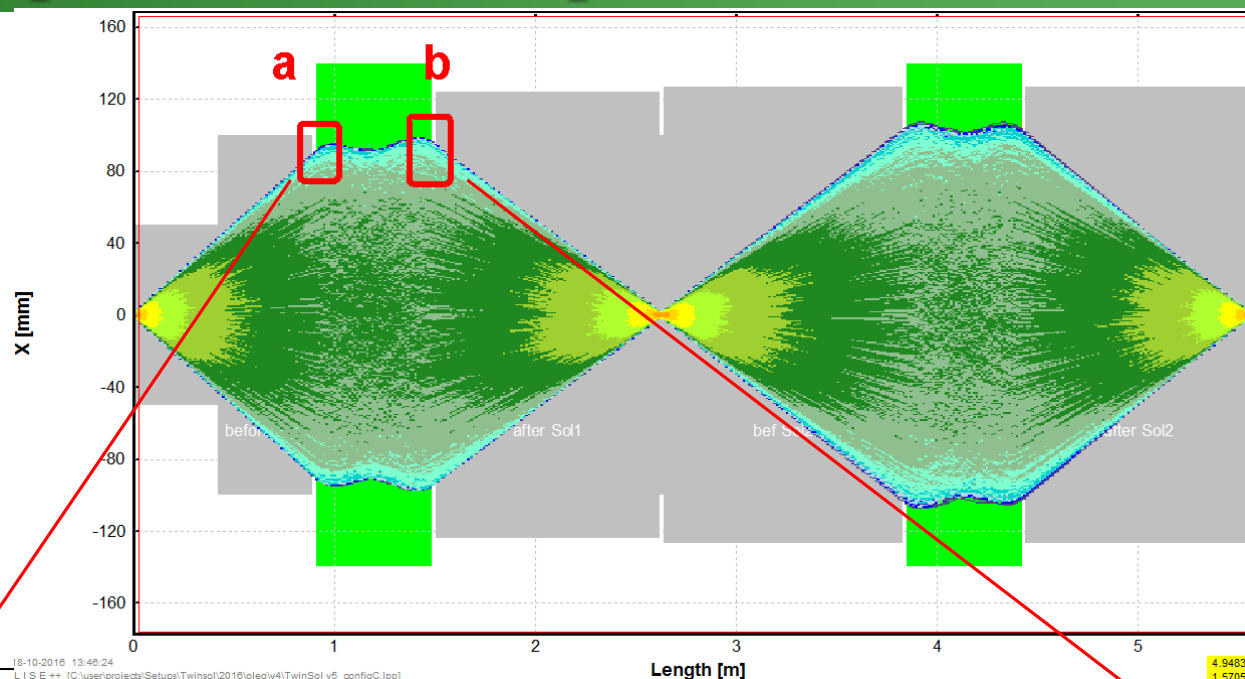


**v.9.10.361**  
**Modified!**

It happened if  $x$  (or  $y$ , or  $r$ ) is larger than  $R_{\text{eff}}$ .

In reality this ray could not pass “TwinSol” : out of its apertures

LISE++ Monte Carlo engine **using gates** allows to find out, to understand some unexpected behavior

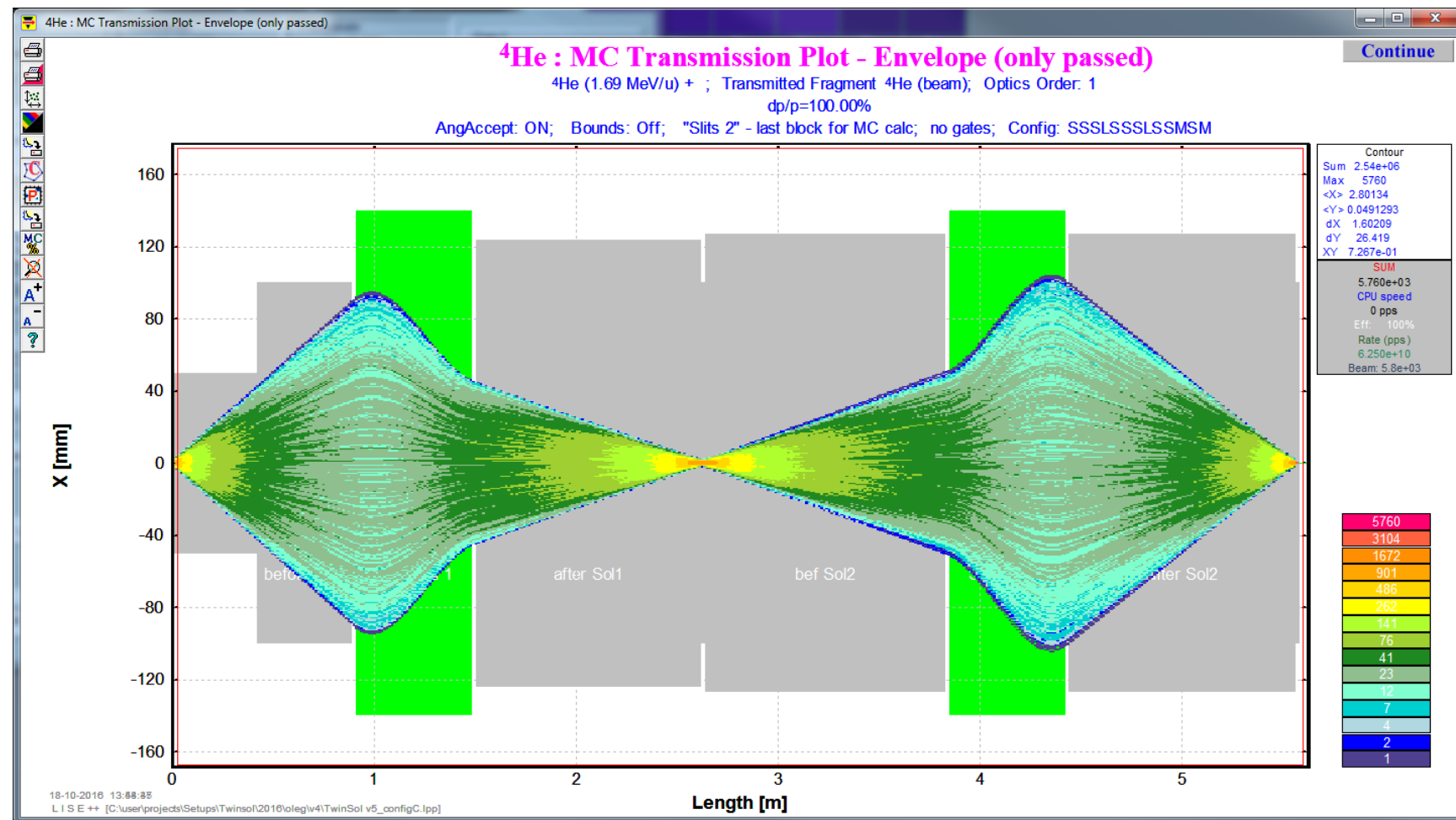




Emittance [#1]

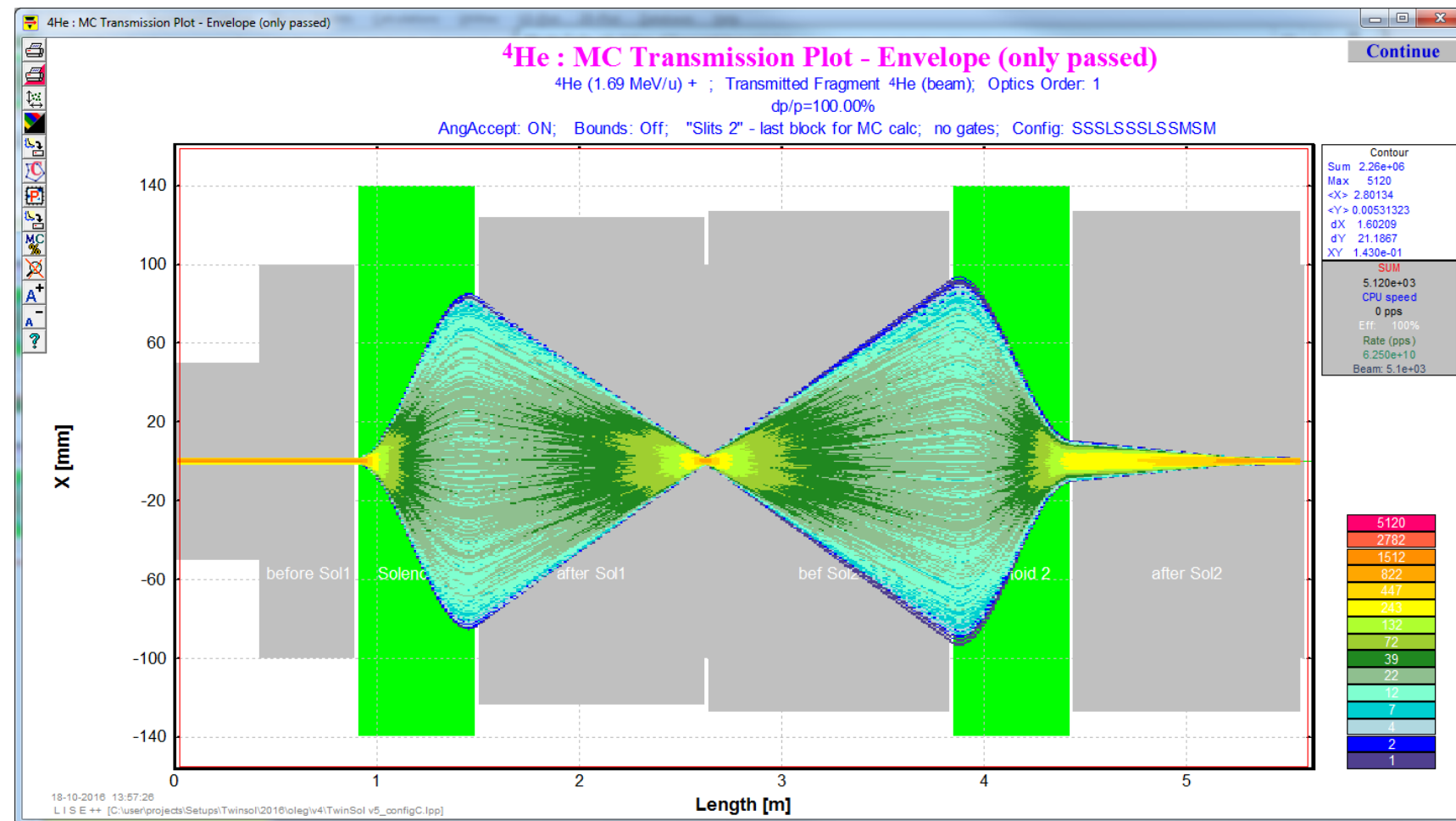
? Beam CARD (sigma, semi-axis, half-width...) 1D - shape (Distribution method)

1. X	mm	1.5	Ellipse uniform (proj.)
2. T	mrad	100	Ellipse uniform (proj.)
3. Y	mm	1.5	Ellipse uniform (proj.)
4. P	mrad	1	Ellipse uniform (proj.)
5. L	mm	0	Gaussian
6. D	%	0.0001	Gaussian



Emittance [#1]

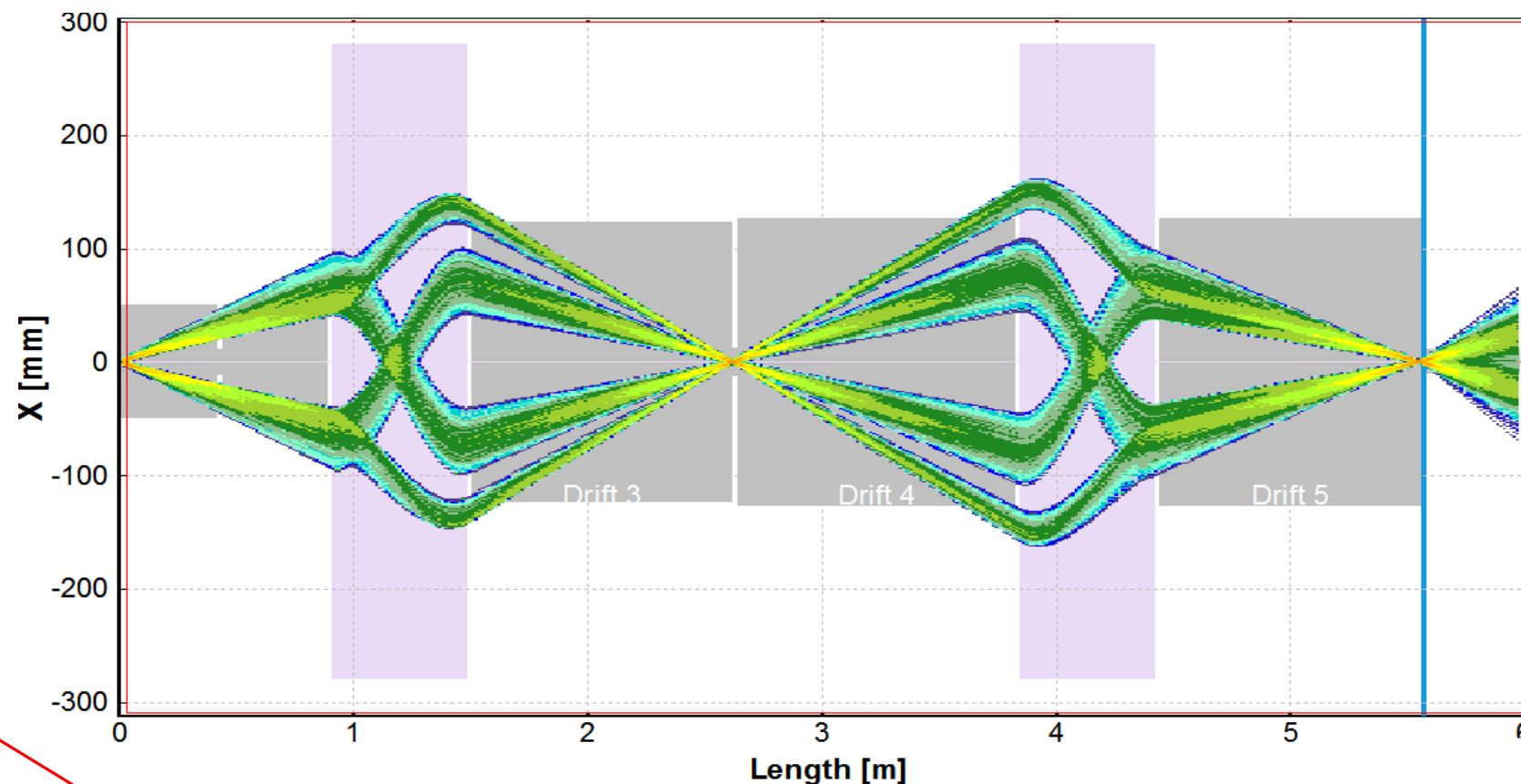
	Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X mm	1.5	Ellipse uniform (proj.)
2. T mrad	0	Ellipse uniform (proj.)
3. Y mm	1.5	Ellipse uniform (proj.)
4. P mrad	100	Ellipse uniform (proj.)
5. L mm	0	Gaussian
6. D %	0.0001	Gaussian



## Beam

Emittance [#1]		1D - shape (Distribution method)		2D mode	2D - shape (Monte Carlo method)	Correlated with
1. X	mm 1.5	Ellipse uniform (proj.)	<input checked="" type="checkbox"/>	Ellipse uniform	Y	
2. T	mrad 150	Ellipse uniform (proj.)	<input checked="" type="checkbox"/>	Ellipse uniform	P	
3. Y	mm 1.5	Ellipse uniform (proj.)	<input checked="" type="checkbox"/>	Ellipse uniform	X	
4. P	mrad 150	Ellipse uniform (proj.)	<input checked="" type="checkbox"/>	Ellipse uniform	T	
5. L	mm 0	Gaussian	<input type="checkbox"/>			
6. D	% 0.0001	Gaussian	<input type="checkbox"/>			

*Do you remember this plot?*



MC gates

Gate 1	
<input checked="" type="checkbox"/>	Settings
"NOT" [-115, 115]	
< Y [mm] > after Solenoid 2	

Gate 2	
<input checked="" type="checkbox"/>	Settings
"AND" [-30, 30]	
< X [mm] > after Crossover	

Gate 3	
<input checked="" type="checkbox"/>	Settings
"NOT" [-20, 20]	
< X [mm] > after Drift 1	

See on the next slide how these gates work on initial X' & Y' distribution

## Beam

Emittance [#1]		Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)	2D mode	2D - shape (Monte Carlo method)	Correlated with
1. X	mm	1.5	Ellipse uniform (proj.)	<input checked="" type="checkbox"/>	Ellipse uniform	Y
2. T	mrاد	150	Ellipse uniform (proj.)	<input checked="" type="checkbox"/>	Ellipse uniform	P
3. Y	mm	1.5	Ellipse uniform (proj.)	<input checked="" type="checkbox"/>	Ellipse uniform	X
4. P	mrاد	150	Ellipse uniform (proj.)	<input checked="" type="checkbox"/>	Ellipse uniform	T
5. L	mm	0	Gaussian	<input type="checkbox"/>		
6. D	%	0.0001	Gaussian	<input type="checkbox"/>		

## MC dialog

**X-coordinate After BLOCK**

Stripper as Y

☐ X mm

☒ X' (T) mrاد

☐ Y mm

☐ Y' (P) mrاد

☐ Radial [ f(X,Y) ] mm

☐ Angle [ f(X',Y') ] mrاد

☐ Energy MeV/u

☐ TKE MeV

☐ Momentum MeV/c

☐ Brho T\*m

☐ Erho MJ/C

☐ Energy Loss MeV

☐ Range mm

☐ Envelope m

☐ Energy Deposition MeV/mm /particle

**Y-coordinate After BLOCK**

Stripper as X

☐ X mm

☐ X' (T) mrاد

☐ Y mm

☒ Y' (P) mrاد

☐ Radial [ f(X,Y) ] mm

☐ Angle [ f(X',Y') ] mrاد

☐ Energy MeV/u

☐ TKE MeV

☐ Momentum MeV/c

☐ Brho T\*m

☐ Erho MJ/C

☐ Energy Loss MeV

☐ Range mm

☐ Envelope m

☐ Energy Deposition MeV/mm /particle

**Gate 1**

☒ Settings

"NOT" [-115, 115]

< Y [mm] > after Solenoid 2

**Gate 2**

☒ Settings

"AND" [-30, 30]

< X [mm] > after Crossover

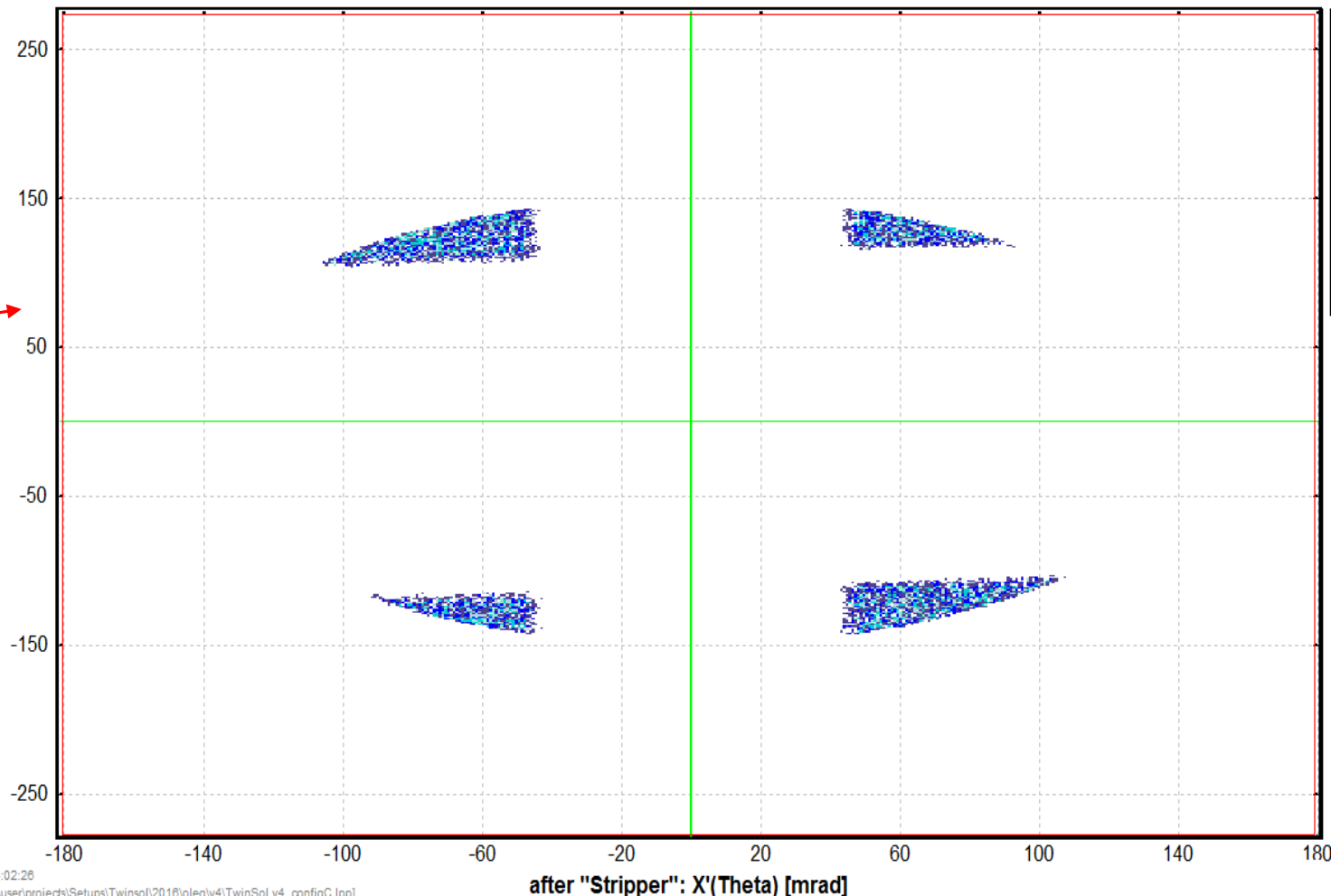
**Gate 3**

☒ Settings

"NOT" [-20, 20]

< X [mm] > after Drift 1

after "Stripper": Y'(Phi) [mrاد]

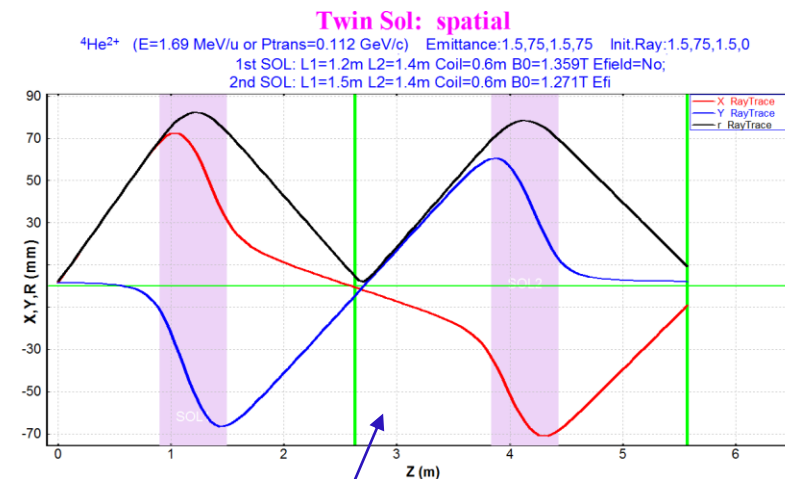


18-10-2016 14:02:28  
I L I S E ++ (C:\user\mriachet\Setup\Twiss\2016\in\ae\ae4\TwissSol v4 mfm\c\in)

# Are there two peaks with Twinsol the utility?

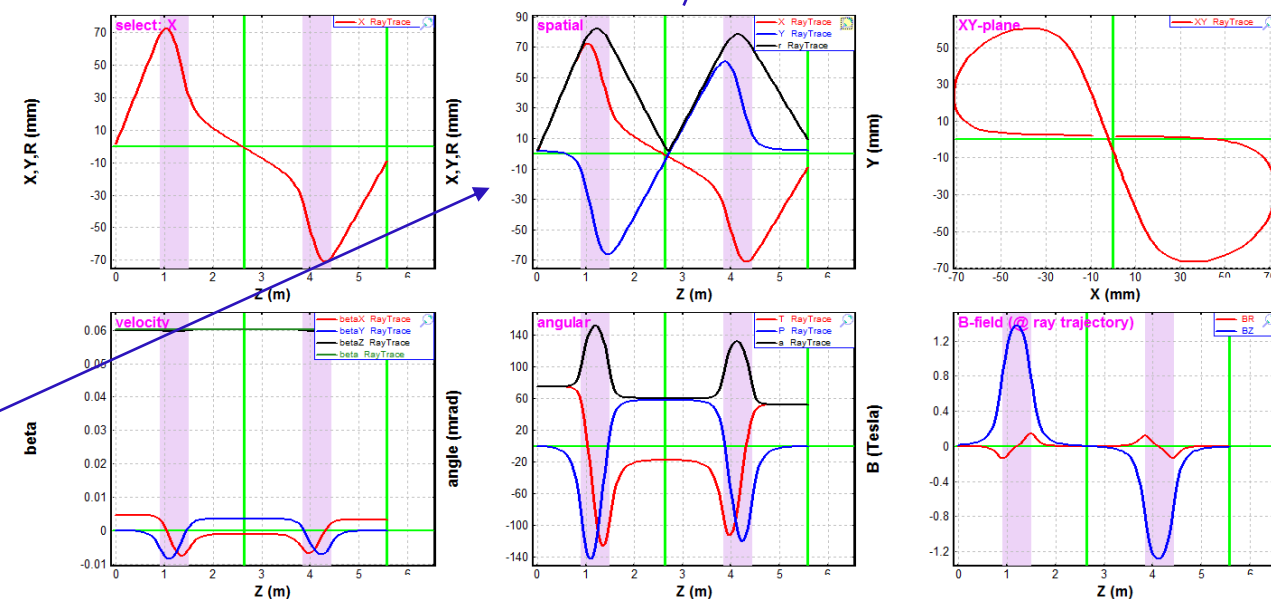
[http://lise.nsl.msui.edu/9\\_10/twinsol\\_2016\\_R\\_0.21.twinsl](http://lise.nsl.msui.edu/9_10/twinsol_2016_R_0.21.twinsl)

See the next page



**Twin Sol**

$^4\text{He}^{2+}$  (E=1.69 MeV/u or Ptrans=0.112 GeV/c) Emittance:1.5,75,1.5,75 Init.Ray:1.5,75,1.5,0  
1st SOL: L1=1.2m L2=1.4m Coil=0.6m B0=1.359T Efield=No; 2nd SOL: L1=1.5m L2=1.4m Coil=0.6m B0=1.271T Efield=No



**TwinSol**

**Twinsol settings**

- ☒ Use the second solenoid
- Twinsol operation mode: ☒ Antiparallel ☐ Parallel
- ☐ Use the defocusing solenoid
- ☐ Use the absorber
- ☒ Use the "soft-edge" corrections for solenoid matrix calculations

**Twinsol optical matrix**

Twinsol Length = 5.572 m  
Distance to plot rays = 5.572 m  
Integration Step = 0.002 m

**Initial Beam**

	Beam emittance	Initial ray values	
1. X	1.5	1.5	mm
2. T	75	75	mrad
3. Y	1.5	1.5	mm
4. F	75	0	mrad
1&3. R	2.12	2.12	mm
2&4. A	106.07	75	mrad

4He<sup>2+</sup> (1.69 MeV/u)  
P trans 0.1124 GeV/c

**1-st solenoid block**

Block Length = 2.63 m  
B = 1.3592 T

**2-nd solenoid block**

Block Length = 2.942 m  
B = 1.2706 T

**Absorber**

Absorber settings  
Distance from target to absorber: 1.954 m  
Charge state after absorber (Z,A): 0

**defocusing solenoid**

Settings  
Optical Matrix  
Length = 1.954 m  
B = 2 T

**Files**

current file: twinsol\_2016\_R\_0.21  
Save file as  
Load file

**Utility**

Function of: 01. beam sigma: X  
from: 1-st solenoid: B\_field Max  
at: 5.572 m  
Distance to plot rays  
Calculate

**Plot options. Show:**

- ☐ Transport: Beam Sigmas
- ☐ Transport: Ray Values
- ☒ Ray Trace
- ☐ Scratch file data

Selected plot: 1. X

Calculate Plot Save & Exit Quit

**Beam tracking**

Distance to plot rays: 5.572 m

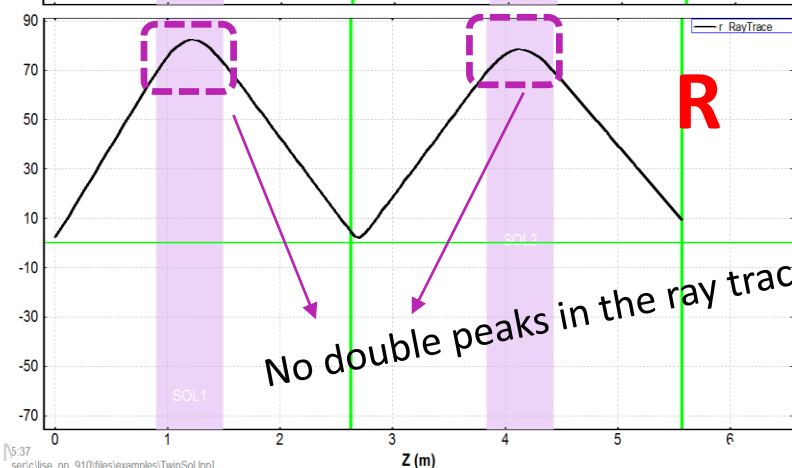
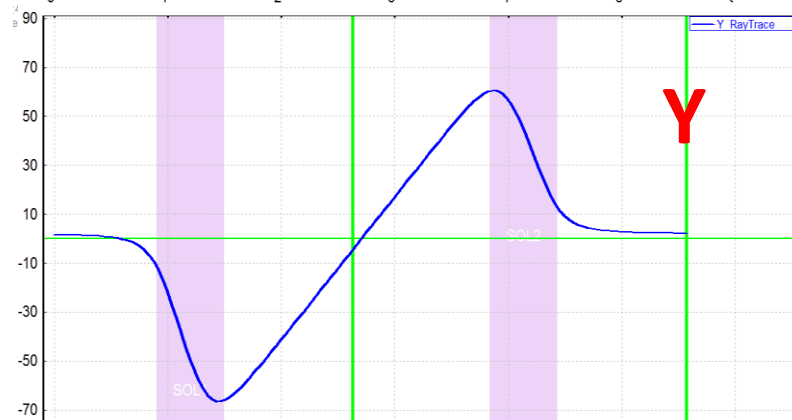
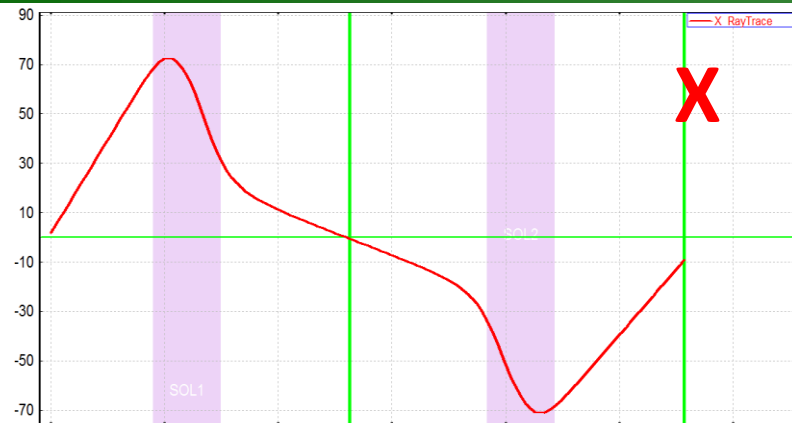
"Transport" (matrix solution)

	Beam sigmas	Ray Values	Ray TRACE
1. X	2.27	3.31	-9.23
2. T	67.87	72.66	52.81
3. Y	2.27	1.54	2.18
4. F	67.87	-0.29	-0.35
1&3. R	3.21	3.65	9.48
2&4. A	95.98	72.67	52.82

Energy (MeV/u) = 1.69  
Time of flight (ns) = 310.27

# Are there two peaks with Twinsol the utility?

From the Twinsol utility



From the Monte Carlo transmission dialog

beam respect to spectrometer

mm ☒ cm

dX 0 mm dY 0 mm dZ 75 mmrad dP 0 mmrad dT 4.3 degrees dP 0 degrees

2D mode ☒ 2D shape (Monte Carlo method) ☒ 1D shape (Distribution method)

Correlated with Y P X T

Beam C4RD (sigma, semi-axis, half-width...)

1. X mm 1.5 2. T mmrad 1 3. Y mm 1.5 4. P mmrad 1 5. L mm 0 6. D % 0.0001

1D shape (Distribution method) Ellipse uniform (proj.) Ellipse uniform (proj.) Ellipse uniform (proj.) Ellipse uniform (proj.) Gaussian Gaussian

