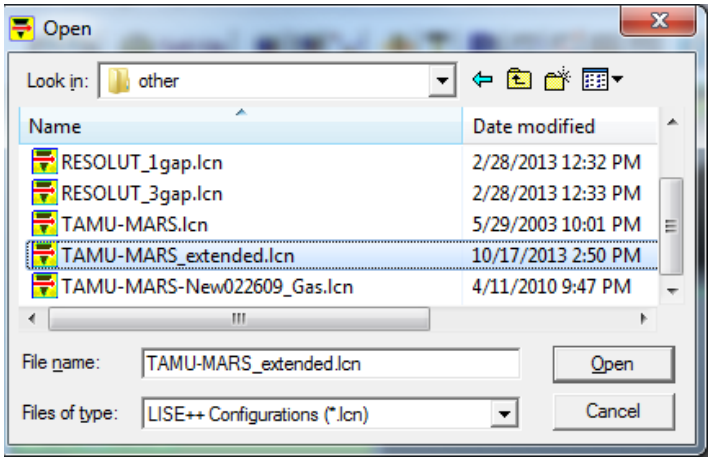
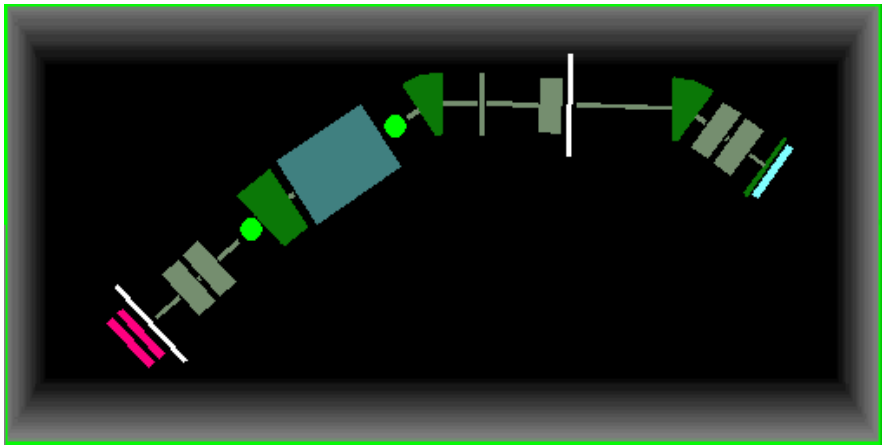
MARS spectrometer extended configuration in the LISE^{++} package





- Use of two rotation blocks for vertical selection performance
- Using regular the “dipole” block instead the “compensating dipole” block
- Vertical dipole parameters (angle, radius) were calculated manually
- Second order optics

LISE^{++} file with the MARS extended configuration for this document

http://lise.nscl.msu.edu/9_6/Mars%20-%202013-Octobver%20%20v2.lpp

MARS spectrometer extended configuration in the LISE^{++} package

Nuclear Instruments and Methods in Physics Research B56/57 (1991) 956–959

MARS: a status report

R.E. Tribble, C.A. Gagliardi and W. Liu

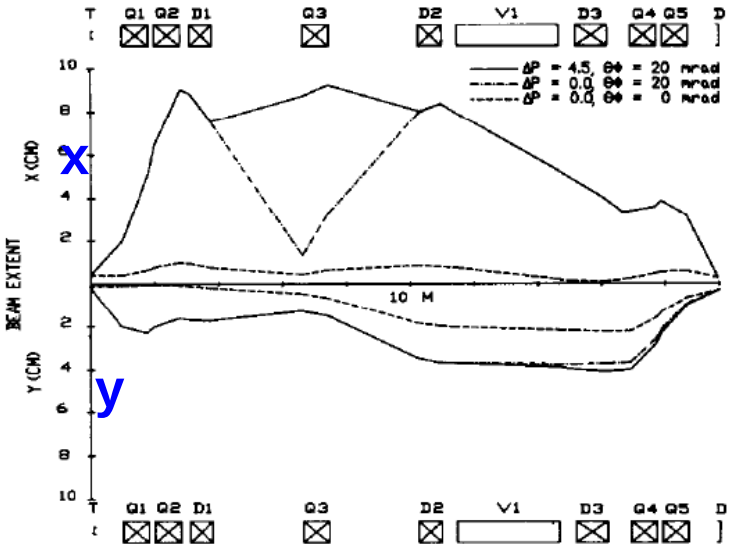
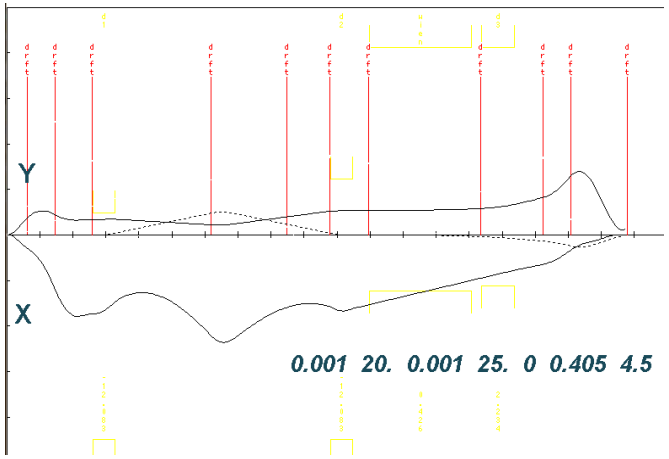


Fig. 2. First order beam optics for MARS from TRANSPORT. The rays are plotted for three different cases. The change in the x beam packet from $\Delta p = 0$ to $\Delta p = 4.5\%$ shows the crossover that occurs near Q3 for small momentum spread.

Transport Framework calculations



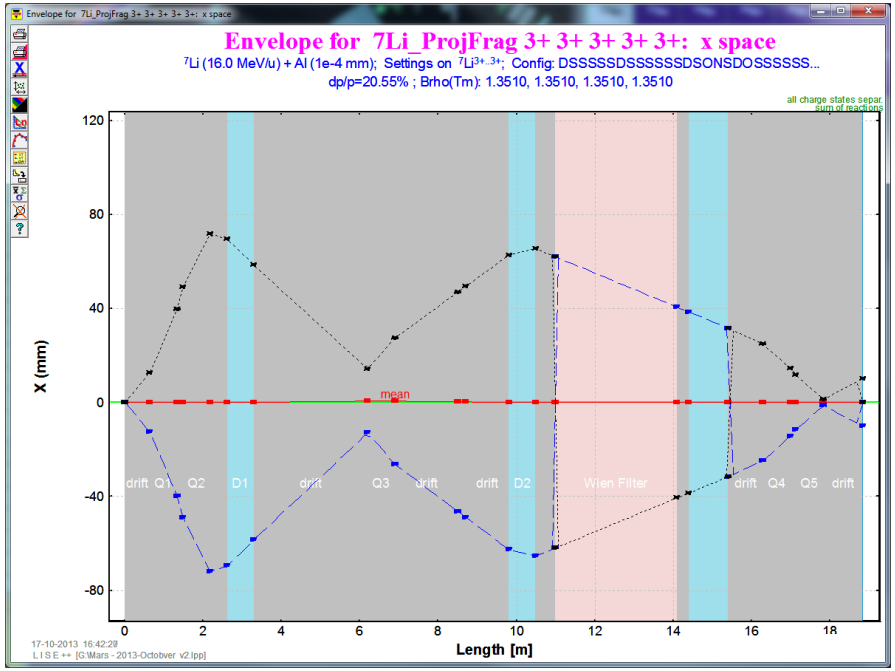
MARS spectrometer extended configuration in the LISE^{++} package

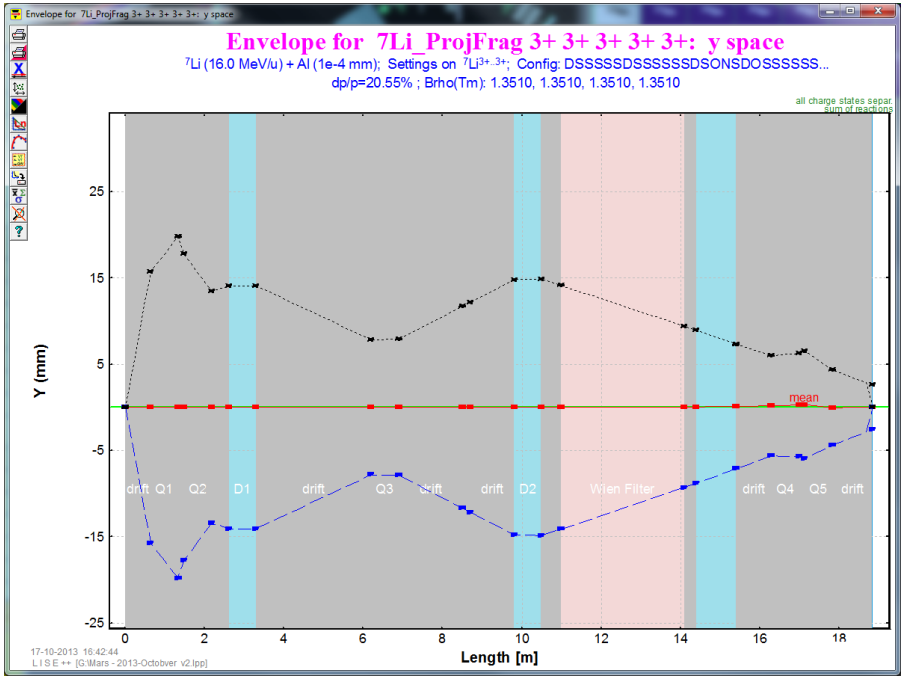
Emittance

	Beam CARD (sigma, semi-axis, half-width...)		1D - shape (Distribution method)
1. X	mm	0.001	Gaussian
2. T	mrad	20	Rectangle uniform
3. Y	mm	0.001	Gaussian
4. P	mrad	25	Rectangle uniform
5. L	mm	1	Gaussian
6. D	%	0.01	Rectangle uniform

Distribution method

for sig(P) = 0.01%



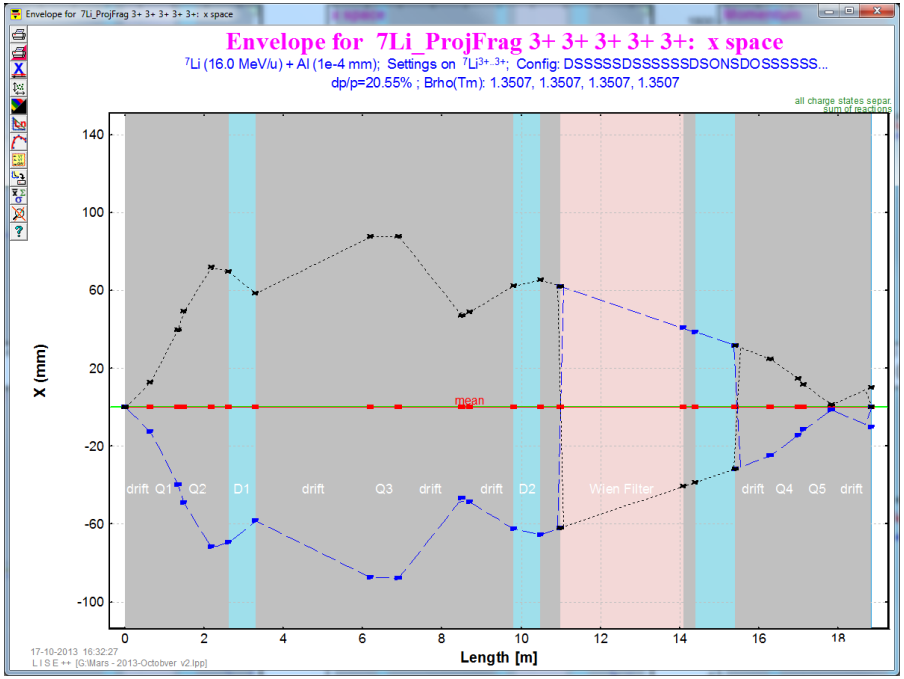


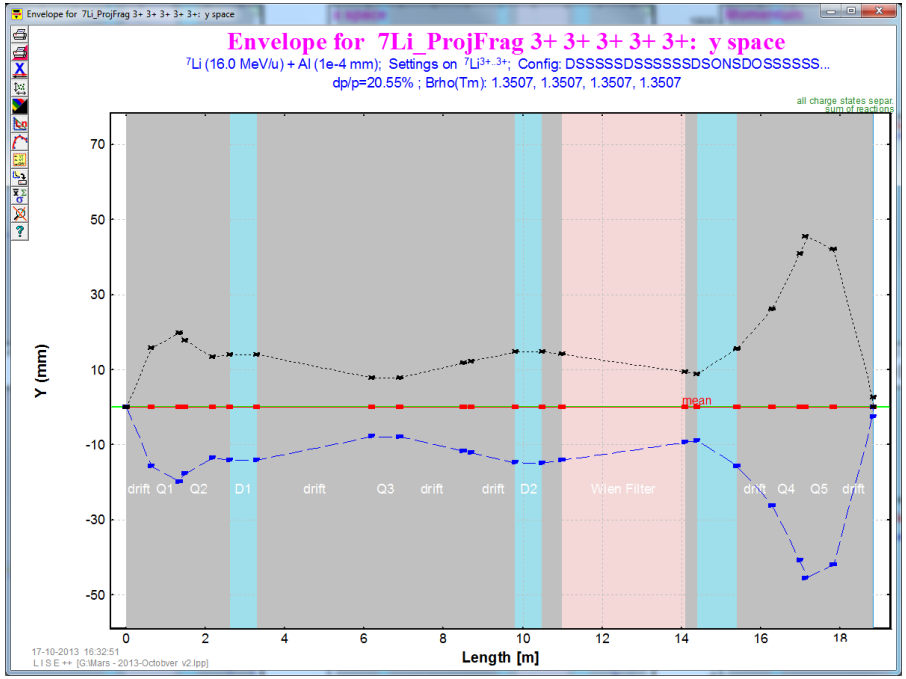
Emittance

		Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X	mm	0.001	Gaussian
2. T	mrad	20	Rectangle uniform
3. Y	mm	0.001	Gaussian
4. P	mrad	25	Rectangle uniform
5. L	mm	1	Gaussian
6. D	%	4.5	Rectangle uniform

Distribution method

for sig(P) = 4.5%





MARS spectrometer extended configuration in the LISE^{++} package

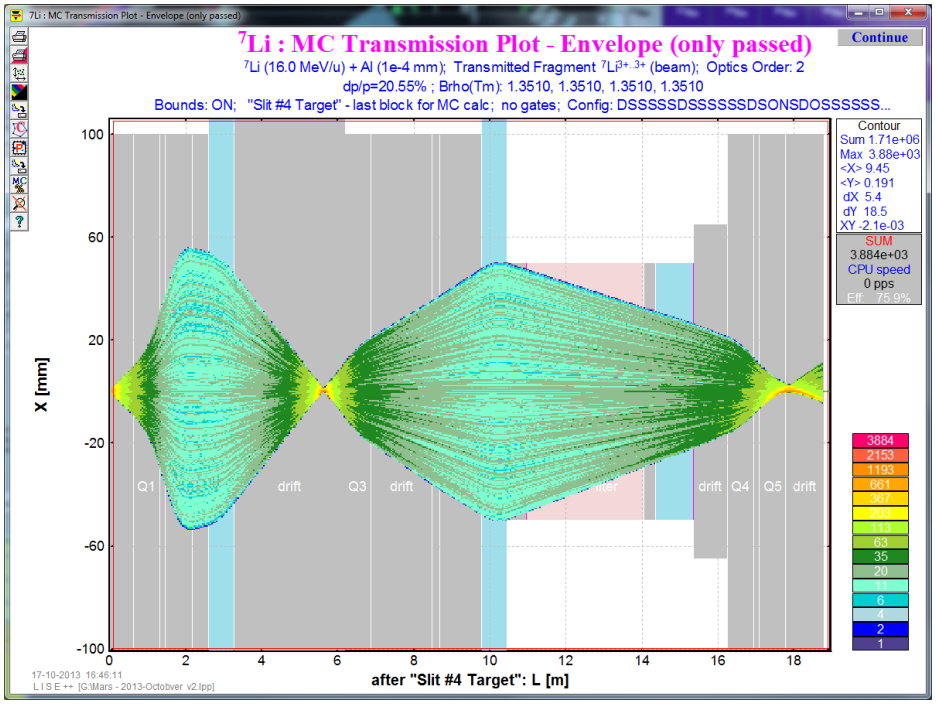
Emittance

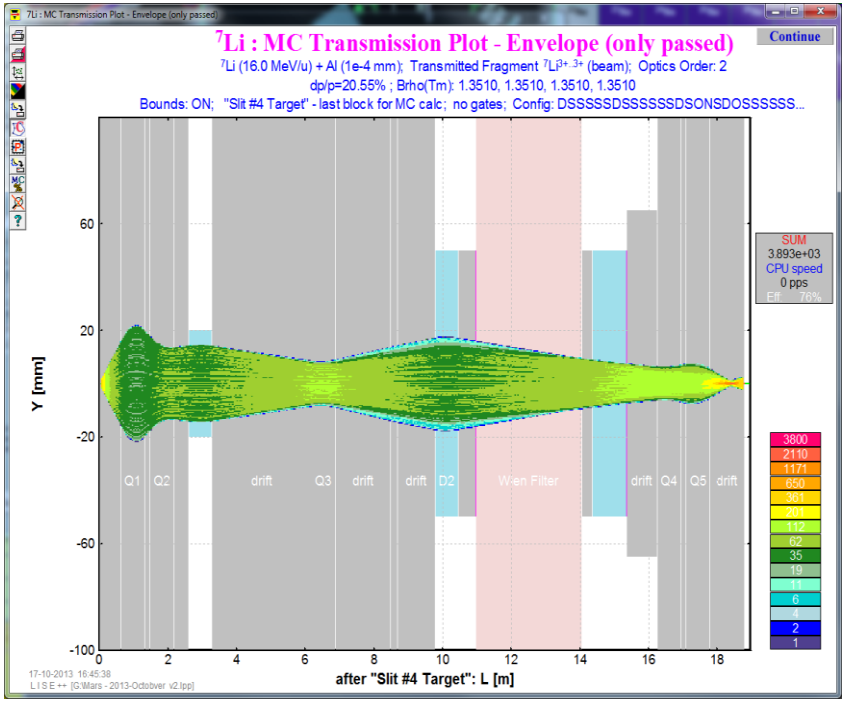
		Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X	mm	0.001	Gaussian
2. T	mrad	20	Rectangle uniform
3. Y	mm	0.001	Gaussian
4. P	mrad	25	Rectangle uniform
5. L	mm	1	Gaussian
6. D	%	0.01	Rectangle uniform

Monte Carlo method

2nd order, transmission ~75%

for sig(P) = 0.01%





MARS spectrometer extended configuration in the LISE^{++} package

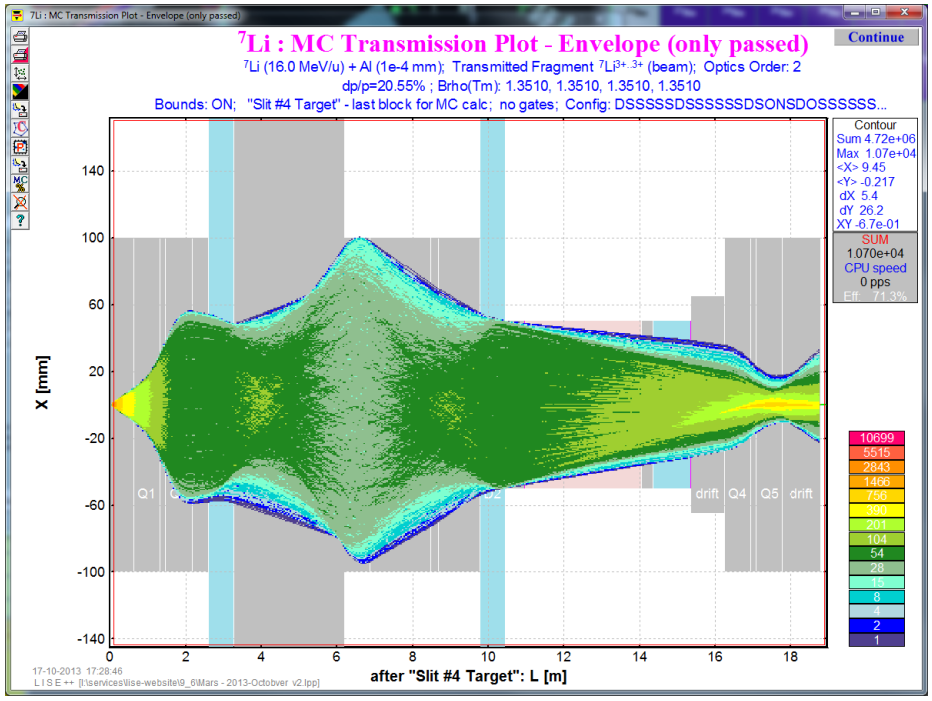
Emittance

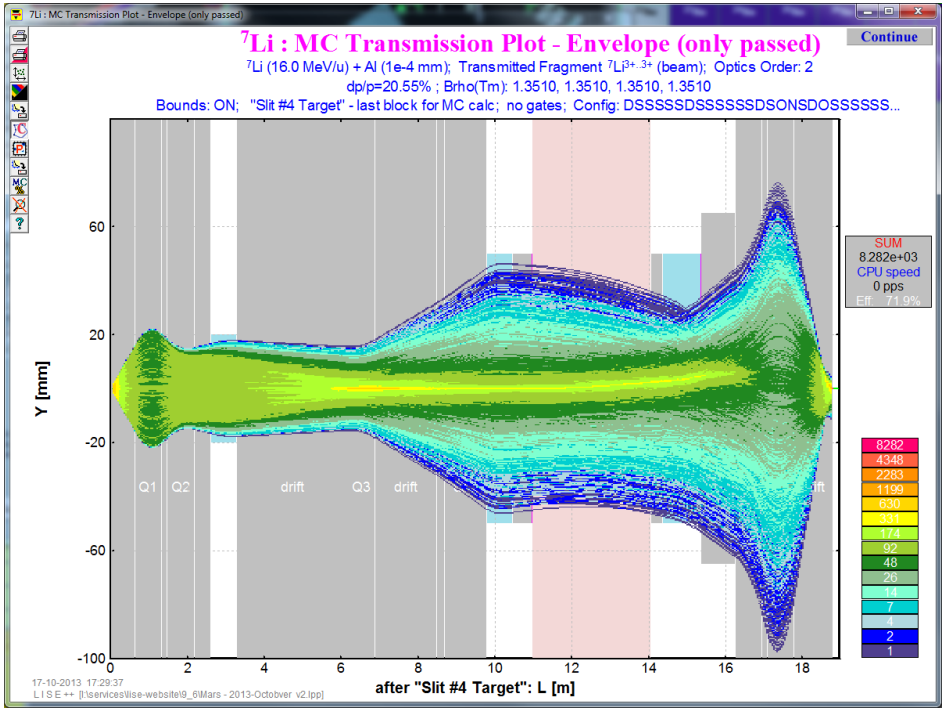
		Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X	mm	0.001	Gaussian
2. T	mrad	20	Rectangle uniform
3. Y	mm	0.001	Gaussian
4. P	mrad	25	Rectangle uniform
5. L	mm	1	Gaussian
6. D	%	4.5	Rectangle uniform

Monte Carlo method

2nd order, transmission ~75%

for sig(P) = 4.5%





Emittance

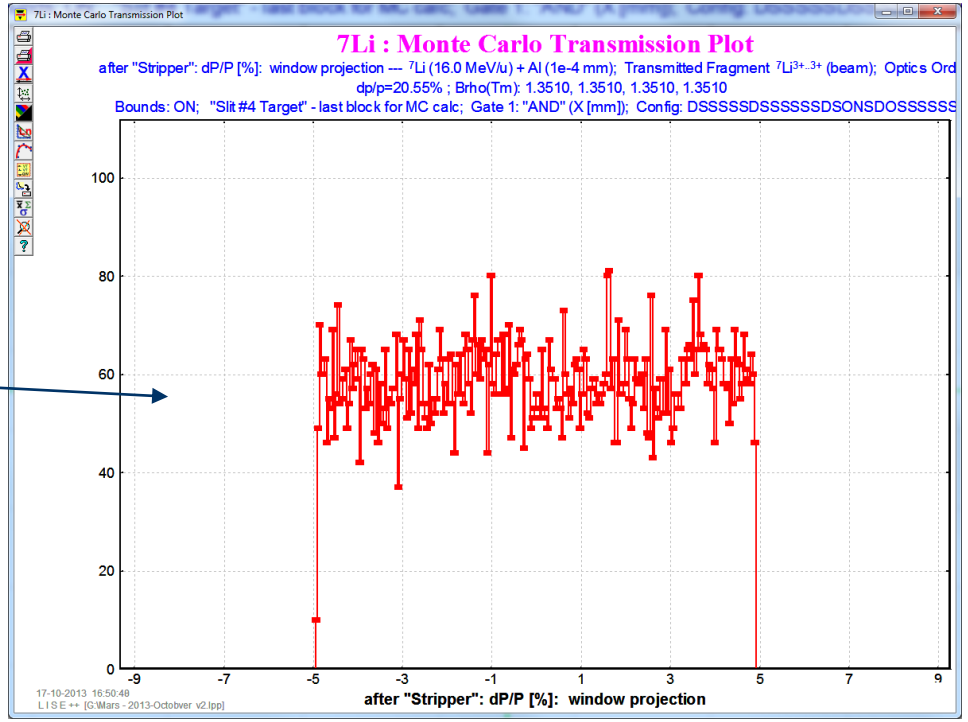
	Beam CARD (sigma, semi-axis, half-width...)		1D - shape (Distribution method)
1. X	mm	0.001	Gaussian
2. T	mrad	0.001	Rectangle uniform
3. Y	mm	0.001	Gaussian
4. P	mrad	0.001	Rectangle uniform
5. L	mm	0.001	Gaussian
6. D	%	8	Rectangle uniform

Monte Carlo method
1st order

What is momentum acceptance?

sig(P) ~ 4.9%

Large energy emittance beam is Gated on Focal plane



Emittance

	Beam CARD (sigma, semi-axis, half-width...)		1D - shape (Distribution method)
1. X	mm	0.001	Gaussian
2. T	mrad	0.001	Rectangle uniform
3. Y	mm	0.001	Gaussian
4. P	mrad	0.001	Rectangle uniform
5. L	mm	0.001	Gaussian
6. D	%	8	Rectangle uniform

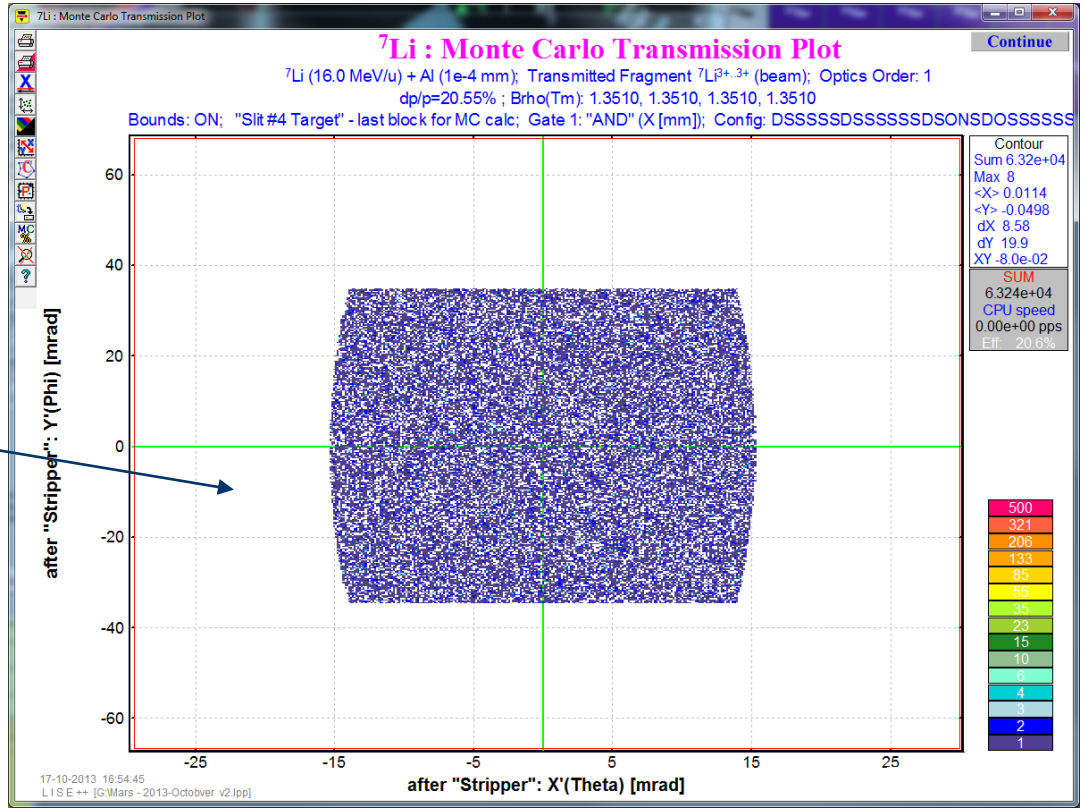
Monte Carlo method

1st order

What is angular acceptance?

T ~ 15 mrad, P ~ 35 mrad

Large angular emittance beam is Gated on Focal plane



Emittance

	Beam CARD (sigma, semi-axis, half-width...)		1D - shape (Distribution method)
1. X	mm	0.001	Gaussian
2. T	mrad	0.001	Rectangle uniform
3. Y	mm	0.001	Gaussian
4. P	mrad	0.001	Rectangle uniform
5. L	mm	0.001	Gaussian
6. D	%	8	Rectangle uniform

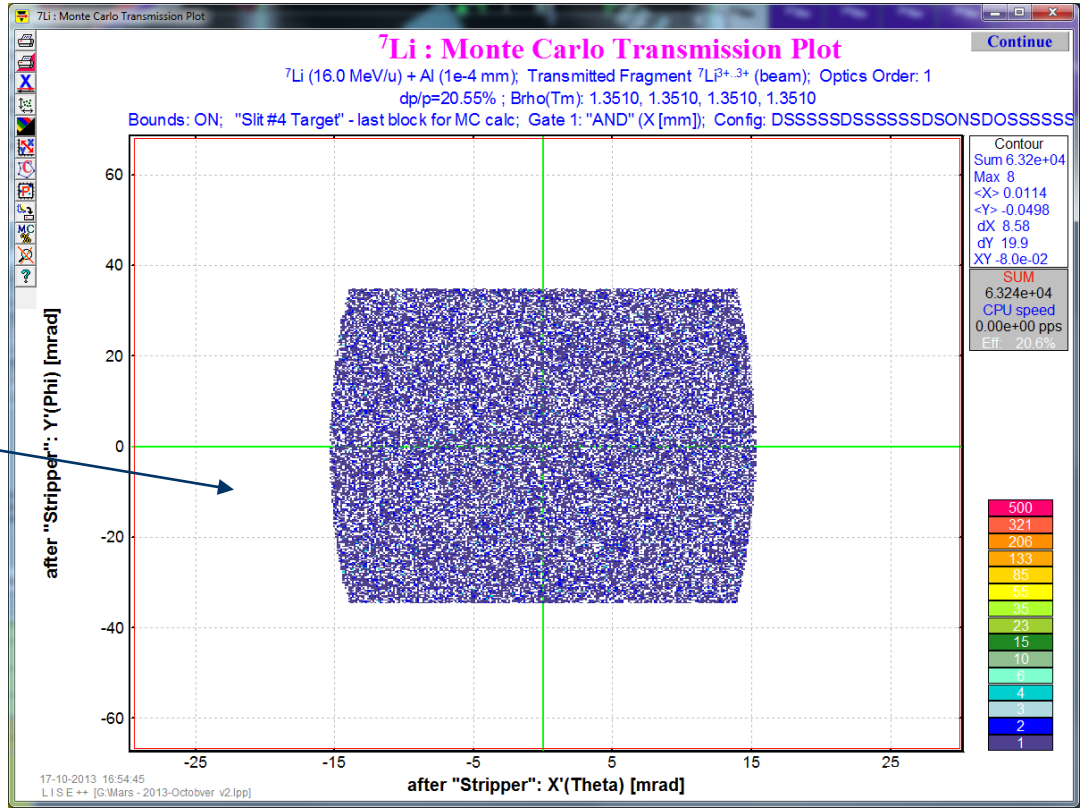
Monte Carlo method

1st order

What is angular acceptance?

T ~ 15 mrad, P ~ 35 mrad

Large angular emittance beam is Gated on Focal plane



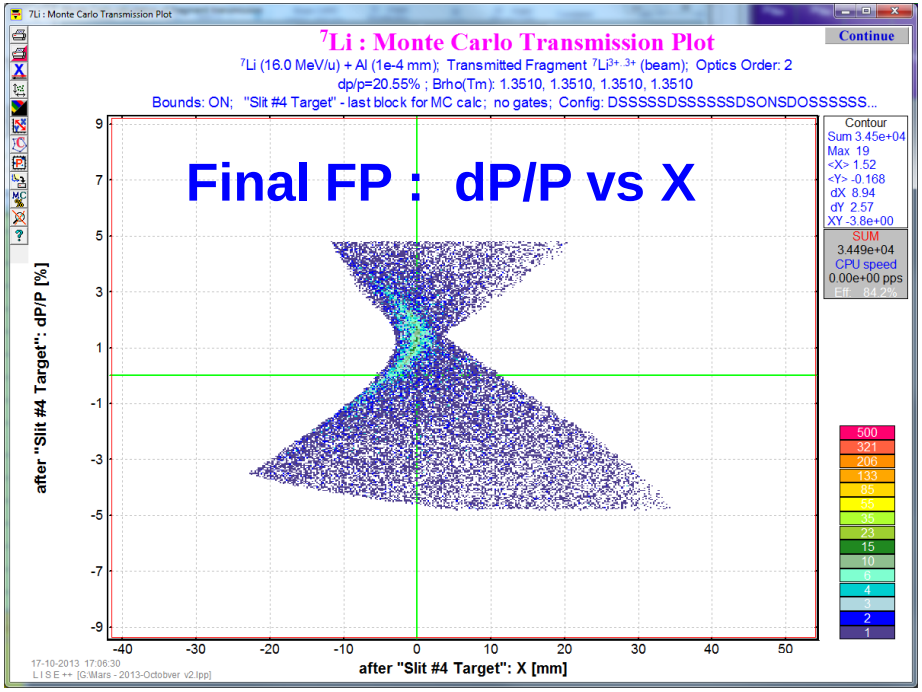
MARS : second order for maximum possible T,P,D emittances

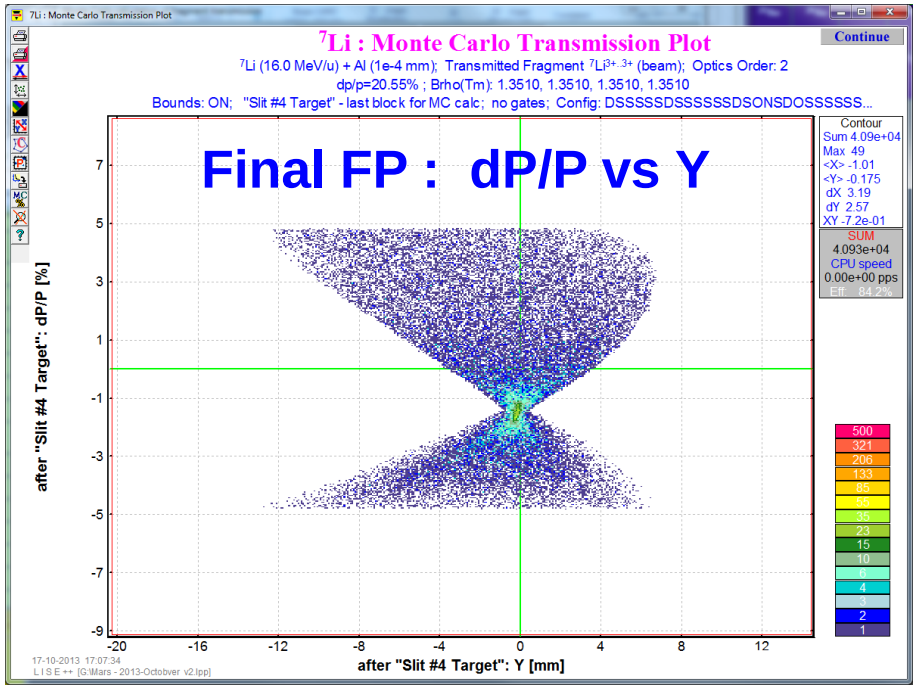
Emittance

		Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X	mm	0.01	Gaussian
2. T	mrad	15	Rectangle uniform
3. Y	mm	0.01	Gaussian
4. P	mrad	35	Rectangle uniform
5. L	mm	0.001	Gaussian
6. D	%	4.8	Rectangle uniform

Monte Carlo method
2nd order
Maximum possible T,P,D- emittances

Transmission 84%





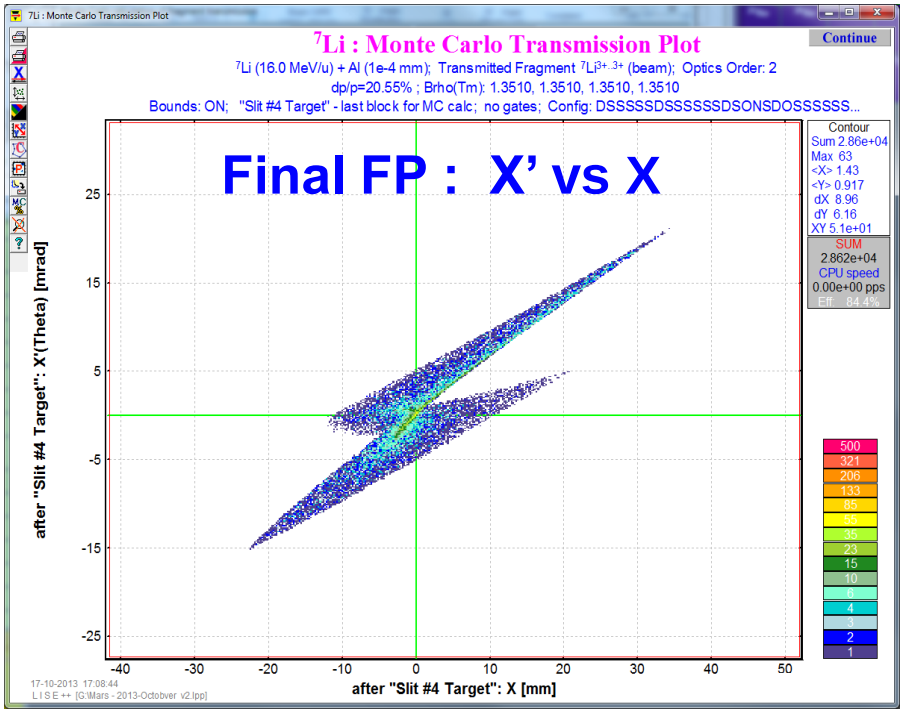
MARS : second order for maximum possible T,P,D emittances

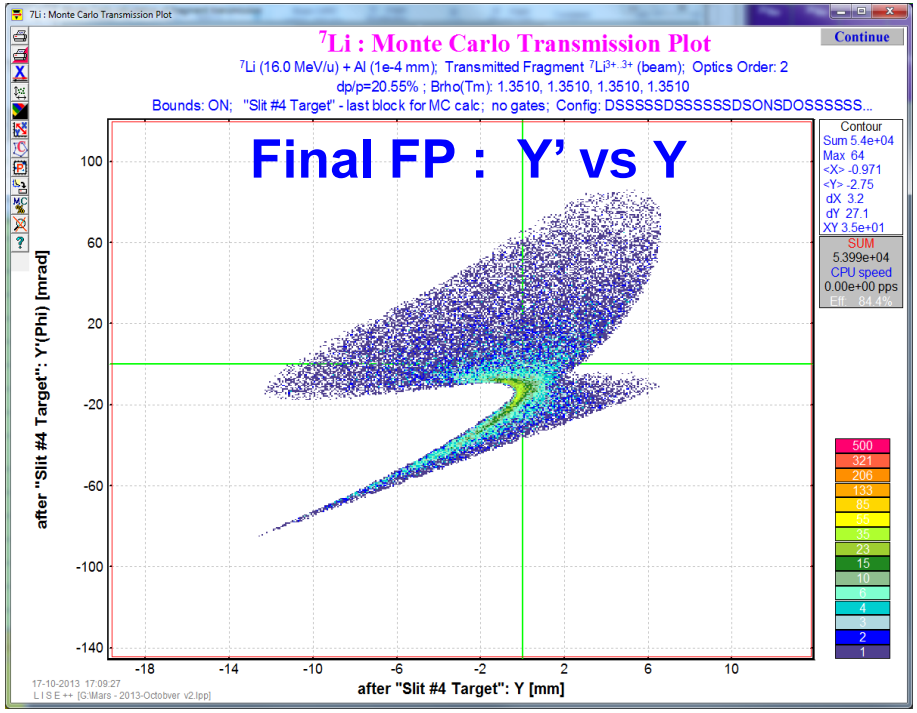
Emittance

		Beam CARD (sigma, semi-axis, half-width...)	1D - shape (Distribution method)
1. X	mm	0.01	Gaussian
2. T	mrad	15	Rectangle uniform
3. Y	mm	0.01	Gaussian
4. P	mrad	35	Rectangle uniform
5. L	mm	0.001	Gaussian
6. D	%	4.8	Rectangle uniform

Monte Carlo method
2nd order
Maximum possible T,P,D- emittances

Transmission 84%





MARS : second order for realistic beam emittances

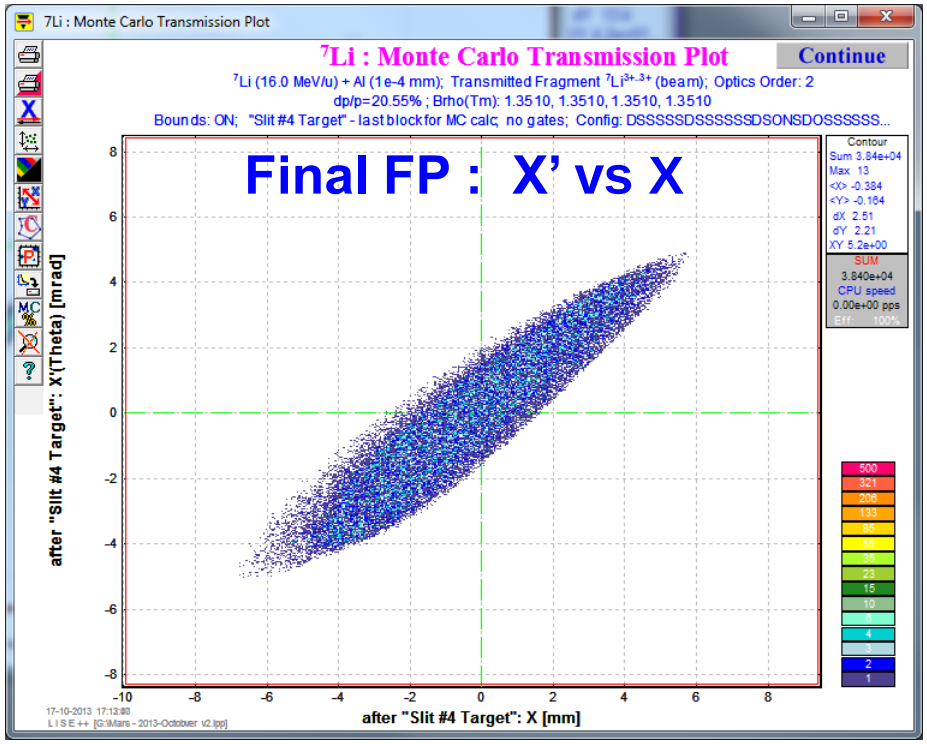
Emittance

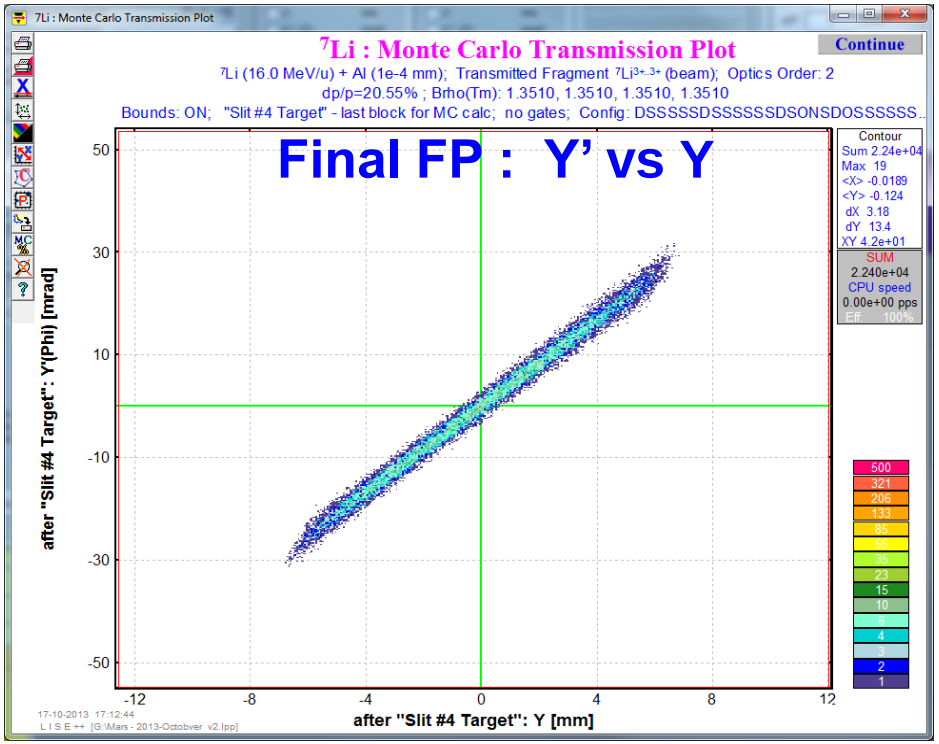
	Beam CARD (sigma, semi-axis, half-width...)		1D - shape (Distribution method)	2D mode	2D - shape (Monte Carlo method)	Correlated with
1. X	mm	1	Ellipse uniform (proj.)	☑	Ellipse uniform	T
2. T	mrad	7	Ellipse uniform (proj.)	☑	Ellipse uniform	X
3. Y	mm	1	Ellipse uniform (proj.)	☑	Ellipse uniform	P
4. P	mrad	7	Ellipse uniform (proj.)	☑	Ellipse uniform	Y
5. L	mm	0.001	Gaussian	☐		
6. D	%	0.1	Gaussian	☐		

Monte Carlo method
2nd order
Realistic beam emittances

Transmission 100%

Bad X & Y resolutions for 1x1 mm² spot





MARS : next steps

- **Improve "Compensating dipole" block in order to simultaneously in this block optimize the platform inclination angle (previous versions) and calculate 2-nd order optical matrix (regular Dipole property)**
- **Consider different shapes of the compensating dipole (circle, sector, rectangle)**
- **Verify optical elements including all apertures and slits sizes**
- **Optimize optics for secondary beam production**
- **Compare experimental results with simulations**