Spectrometer "MSP-144" @ LISE^{++} :

High Order extended configuration

Version 9.8.176
from 12/24/2014

Link: Spectrometer "MSP-144" (FLNR/JINR)

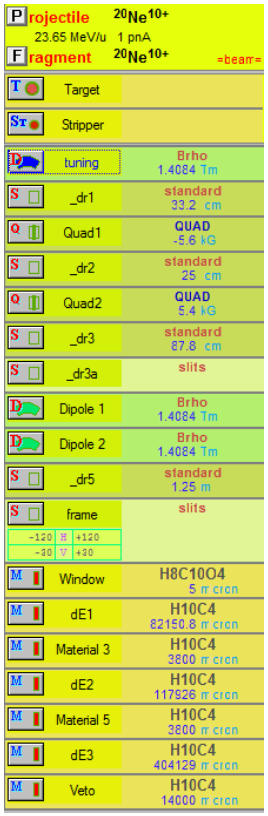
- MSP-144 extended configurations in LISE^{++}
- Introduction
- Configurations
- Angular Acceptance
- Momentum Acceptance
- Envelopes
- Turn of the spectrometer

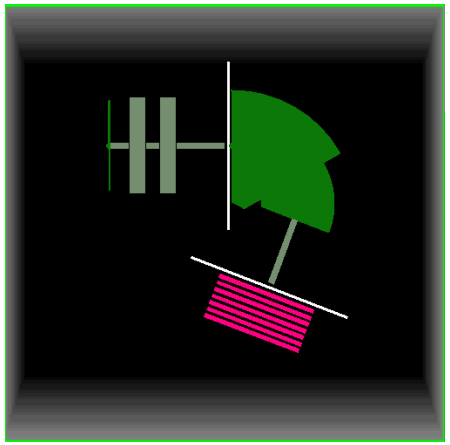
MSP-144 high order extended configuration

Configuration files Path /config/Dubna/

\lise\config\Dubna*.*

Name	↑Ext	Size	Date
[..]		<DIR>	12/24/2014
Acculinna	lcn	16,163	07/01/2003
Acculinna2_extended	lcn	269,177	02/18/2013
COMBAS	lcn	18,801	07/01/2003
Dubna_GFS	lcn	16,551	11/04/2003
eMSP144	lcn	78,041	12/24/2014
MASHA	lcn	21,601	01/13/2004
MSP144	lcn	35,516	07/01/2003
SHELS	lcn	156,911	11/26/2014
Vassilissa	lcn	32,332	01/13/2004





LISE++ files Path /files/examples/dubna/

\lise\files\examples\dubna*.*

Name	↑Ext	Size	Date
[..]		<DIR>	12/24/2014
acculinna_6he	lpp	46,201	02/16/2012
acculinna2	lpp	287,285	02/06/2013
acculinna2_extended	lpp	287,269	02/18/2013
combas_test	lpp	42,159	02/16/2012
Dubna_GFS	lpp	39,955	02/16/2012
eMSP144	lpp	97,631	12/24/2014
Masha	lpp	42,496	02/16/2012
msp144_48ca	lpp	53,135	02/16/2012
SHELS	lpp	184,666	11/26/2014
vassilissa_22ne_au_states	lpp	54,837	02/16/2012

Note: It's an extended configuration! For details on extended configuration approach please use the next link
http://lise.nscl.msu.edu/9_8/LISE3/Extended%20configurations%20at%20LISE++.pdf

Introduction

2014: Two quadrupoles have to be inserted between the target box and the separator in order to increase angular acceptance

ELSEVIER
Nuclear Instruments and Methods in Physics Research A 411 (1998) 343–350
NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A

A facility for the study of neutron-rich light nuclei

A.V. Belozyorov[a], J. Vincour[b,*], Š. Piskoř[b], R. Kalpakchieva[a], Yu.E. Penionzhkevich[a], V.S. Salamatin[a], V.E. Zhuchko[a]

Table 1
Some parameters of MSP-144

Gap of 1st dipole region (mm)	47
Gap of 2nd dipole region (mm)	30
Max. magnetic rigidity, $B\rho$ (Tm)	1.5
Focal line angle (deg)	41
Relation of energy, E_{max}/E_{min}	5.2
Energy resolution, $\Delta E/E$	5×10^{-4}

- the MSP-144 positioned at a reaction angle of 4°,
- the 8 mm width of the entrance slit of the MSP-144,
- the diaphragm with a $170 \times 20\,mm^2$ aperture placed beyond the entrance pole edges at a distance of 751 mm from the target.

This disposition of the MSP-144 determines the entrance solid angle of 0.49 msr.

4. Detector performance

The focal plane detector [6] consists of a gas filled, gridded ionization chamber with a segmented anode and two single wire proportional counters. A schematic cross section of the focal plane detector is shown in Fig. 4.

We used an ionization chamber 500 mm deep, 240 mm wide and 65 mm high. The distance between the anode and the Frisch grid and between the Frisch grid and the cathode is 8 and 37 mm.

MSP – 144 information:

NUCLEAR INSTRUMENTS AND METHODS 126 (1975) 413–416; © NORTH-HOLLAND PUBLISHING CO.

A BROAD-RANGE STEPPED-POLE MAGNETIC SPECTROGRAPH

YU. G. BASARGIN, N. I. BOLDIN, L. E. KOROLEV, V. G. LEVCHENKO and YU. P. SEVERGIN
D. V. Efremov Scientific Research Institute of Electrophysical Apparatus, Leningrad, USSR
and
YU. V. GOFMAN and V. Z. MAIDIKOV

In the described broad-range spectrograph the momenta of simultaneously recorded particles differ by a factor of 2.6. The maximum radius of the central trajectory in the region I is $\rho_{Imax} = 125$ cm; the field-strength ratio in the two regions is $K = 1.55$. The angle of deflection in the first region is 60°, in the second one is 51°. In the region I the entrance "edge" angle is $\varepsilon_1 = +60°$, the exit one $\varepsilon_2 = -60°$, and in the region II $\varepsilon_1 = +60°$ and $\varepsilon_2 = -28.5°$. The source-to-entrance boundary spacing is 62.5 cm. The smaller gap width (in the region II) is 30 mm, the bigger gap width is 47 mm. The focal line is 150 cm long and it differs from a straight line not more than ±5 mm; the focal-line slope with respect to the central trajectories is 40°.

The calculated α dependences of the magnetic-field

Configurations

There were three sources to build QQDD configuration

1. "MSP-144_X" COSY file. This file contains 70 mm aperture quads. Effective quad length used in the configuration corresponds to the "coef" =0.9, where L_eff = L_iron + HalfAperture * coef. Using this COSY file the LISE++ file "**eMSP144_cosyX.lpp**" has been created. Large X-magnification (2.48) and defocusing (0.5 mm/mrad) values been obtained with both COSY and LISE++ calculations.

Global matrix

2.4796	0.05233	0	0	0	1.51463	[cm]
74.323	1.97187	0	0	0	-0.12864	[mrad]
0	0	8.58226	-0.30827	0	0	[cm]
0	0	51.48136	-1.73265	0	0	[mrad]
11.28911	0.29934	0	0	1	-1.20456	[cm]
0	0	0	0	0	1	[%]

2. "MSP-144_Y" COSY file. This file contains 110 mm aperture quads. Effective quad length used in the configuration corresponds to the "coef" =0.9, where L_eff = L_iron + HalfAperture * coef. Using this COSY file the LISE++ file "**eMSP144_cosyY.lpp**". Smaller X-magnification (0.15) and defocusing (-0.29 mm/mrad) values been obtained with both COSY and LISE++ calculations.

Global matrix

0.15006	-0.02898	0	0	0	1.51749	[cm]
31.51222	0.57701	0	0	0	-0.12867	[mrad]
0	0	5.78907	-0.34061	0	0	[cm]
0	0	36.35833	-1.96651	0	0	[mrad]
4.78397	0.08719	0	0	1	-1.20457	[cm]
0	0	0	0	0	1	[%]
/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]	

3. The third source was a MSP144 sketch with drift distances. The "eMSP144.lpp" LISE++ file has been created on this sketch and some parameters taken from "MSP-144_Y" COSY file. For effective quad lengths the "coef" has been used equal to 0.7 which was obtain in measurement in Dubna (SHELS) and MSU (A1900).

   a. Q2-field "0.54 T" provides zero X-magnification : "**eMSP144_a.lpp**"

Global matrix

0.03933	-0.03302	0	0	0	1.51749	[cm]
29.63297	0.55087	0	0	0	-0.12864	[mrad]
0	0	3.4684	-0.29538	0	0	[cm]
0	0	24.32144	-1.783	0	0	[mrad]
4.49728	0.08317	0	0	1	-1.20456	[cm]
0	0	0	0	0	1	[%]
/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]	

   b. Q2-field "0.603 T" provides X-focus at the end of spectrometer : "**eMSP144_b.lpp**"

Global matrix

0.5166	-0.00016	0	0	0	1.51749	[cm]
49.51072	1.92071	0	0	0	-0.12865	[mrad]
0	0	3.51039	-0.31344	0	0	[cm]
0	0	24.68305	-1.91904	0	0	[mrad]
7.51983	0.29146	0	0	1	-1.20456	[cm]
0	0	0	0	0	1	[%]

Important: in the COSY files half-apertures of 5 cm were used for both dipoles. In reality the values of 2.3 cm and 1.5 cm should be set. These values defines vertical acceptance and important for matrix calculations. The final file "eMSP144.lpp" used these last values.

Configurations : “eMSP144_cosyX” file

	Lengths mm					
	effective	iron	delta	fileds	Quad-eff coef	HalfApp
drift	100	115				
quad1	330	300	15	-0.55	0.857	35
drift	220	250				
quad2	330	300	15	0.45	0.857	35
drift	825	840				
D1	g/2	5	cm			
D2	g/2	5	cm			
drift	1470					

COSY

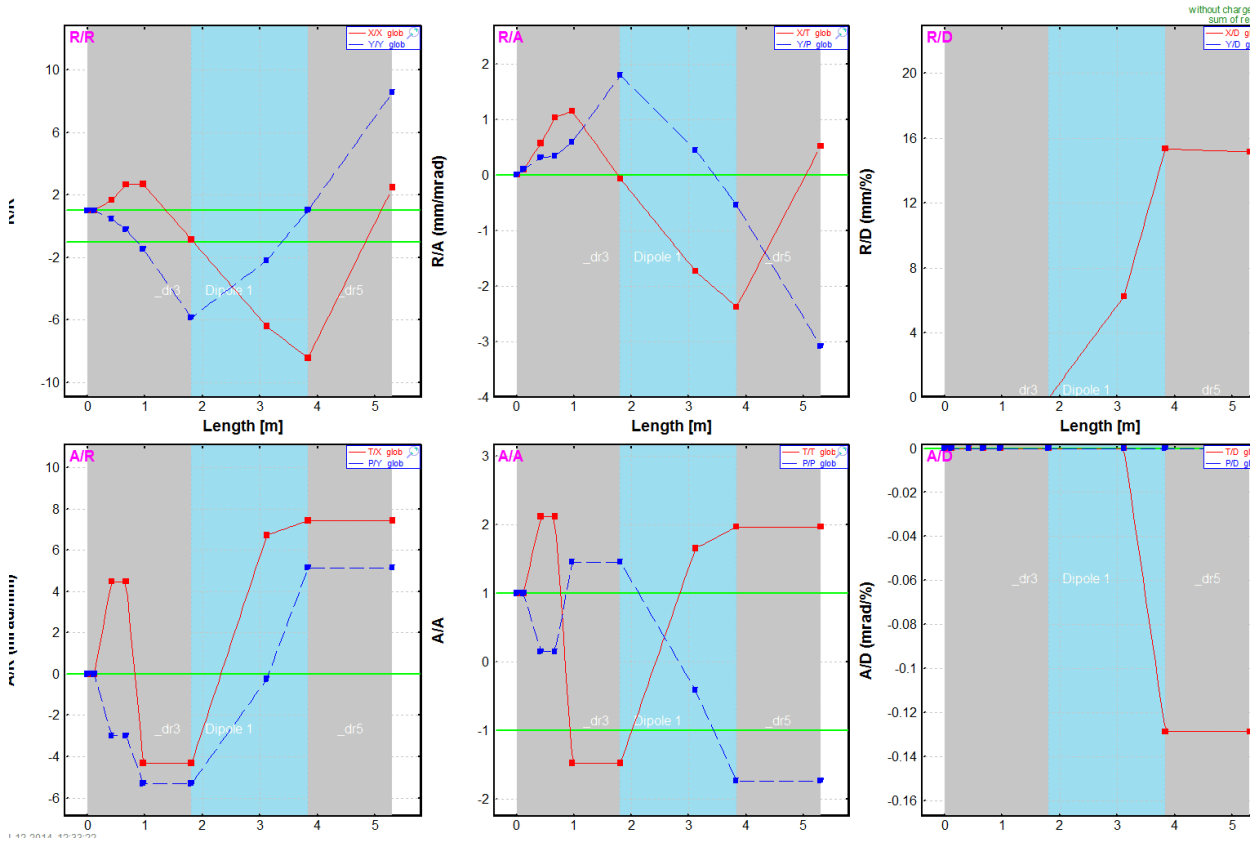
```
6 1
 .24763E+01   .52193E-01   .00000E+00   .00000E+00   .00000E+00   .15146E+01
 .74245E+02   .19687E+01   .00000E+00   .00000E+00   .00000E+00  -.12864E+00
 .00000E+00   .00000E+00   .85781E+01  -.30835E+00   .00000E+00   .00000E+00
 .00000E+00   .00000E+00   .51456E+02  -.17330E+01   .00000E+00   .00000E+00
 .11277E+02   .29886E+00   .00000E+00   .00000E+00   .10000E+01  -.12046E+01
 .00000E+00   .00000E+00   .00000E+00   .00000E+00   .00000E+00   .10000E+01
```

LISE^{++}

Global matrix

2.4796	0.05233	0	0	0	1.51463	[cm]
74.323	1.97187	0	0	0	-0.12864	[mrad]
0	0	8.58226	-0.30827	0	0	[cm]
0	0	51.48136	-1.73265	0	0	[mrad]
11.28911	0.29934	0	0	1	-1.20456	[cm]
0	0	0	0	0	1	[%]

^{20}Ne (23.7 MeV/u); Settings on ^{20}Ne; Config: SSSSSDDSSMMMMMMM
dp/p=66.02% ; Brho(Tm): 1.4084, 1.4084



Configurations : “eMSP-144_cosyY” file

	Lengths mm					
BLOCK	effective	iron	delta	fileds	Quad-eff coef	HalfApp
drift	300	325				
quad1	350	300	25	-0.56	0.909	55
drift	230	280				
quad2	350	300	25	0.492	0.909	55
drift	1025	1050				
D1	g/2	5	cm			
D2	g/2	5	cm			
drift	1248					

COSY

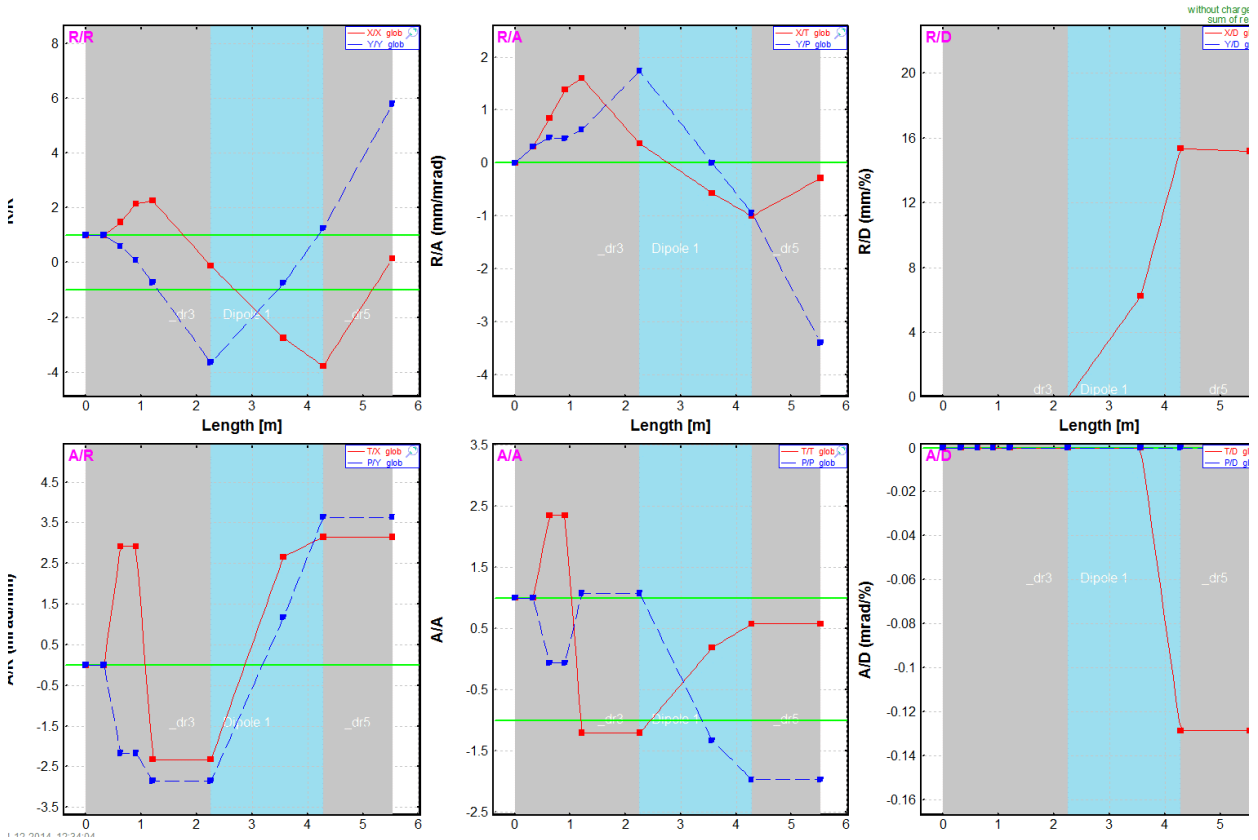
```
6 1
 .14881E+00  -.29079E-01   .00000E+00   .00000E+00   .00000E+00   .15175E+01
 .31457E+02   .57299E+00   .00000E+00   .00000E+00   .00000E+00  -.12864E+00
 .00000E+00   .00000E+00   .57849E+01  -.34072E+00   .00000E+00   .00000E+00
 .00000E+00   .00000E+00   .36333E+02  -.19671E+01   .00000E+00   .00000E+00
 .47755E+01   .86577E-01   .00000E+00   .00000E+00   .10000E+01  -.12046E+01
 .00000E+00   .00000E+00   .00000E+00   .00000E+00   .00000E+00   .10000E+01
```

LISE++

Global matrix

0.15006	-0.02898	0	0	0	1.51749	[cm]
31.51222	0.57701	0	0	0	-0.12867	[mrad]
0	0	5.78907	-0.34061	0	0	[cm]
0	0	36.35833	-1.96651	0	0	[mrad]
4.78397	0.08719	0	0	1	-1.20457	[cm]
0	0	0	0	0	1	[%]
/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]	

^{20}Ne (23.7 MeV/u); Settings on ^{20}Ne; Config: SSSSSDDSSMMMMMMM
dp/p=65.90% ; Brho(Tm): 1.4084, 1.4084



Configurations : “eMSP144_a.lpp” file

	Lengths mm				
	effective	iron	delta	fileds	Quad-eff coef
drift	312.75	332			
quad1	338.5	300	19.25	-0.56	0.700
drift	211.5	250			
quad2	338.5	300	19.25	0.54	0.700
drift	858.75	878			
D1	g/2	2.35	cm		
D2	g/2	1.5	cm		
drift	1470				
Here is zero X-magnification					

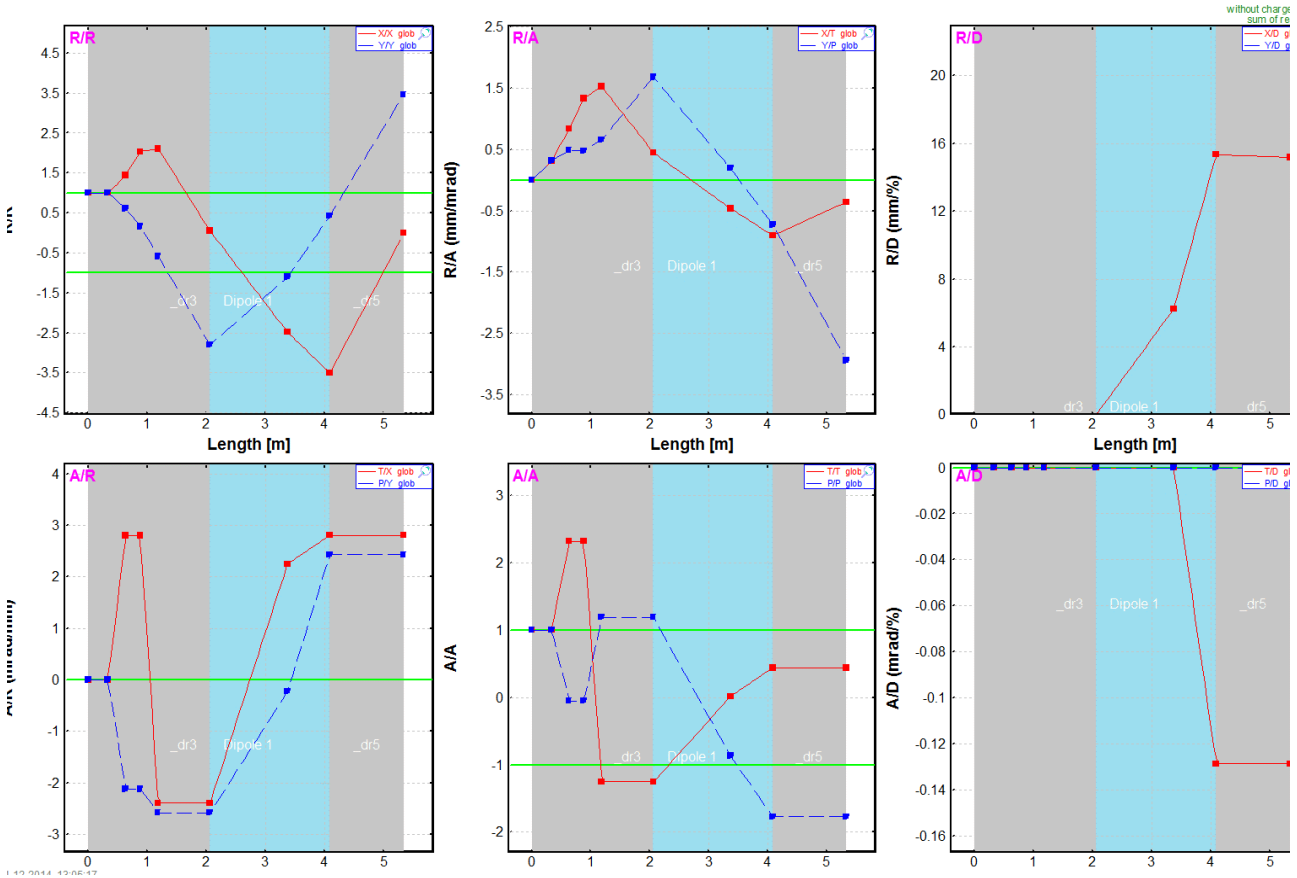
Changed according to the original MSP144 information

LISE++

Global matrix

0.03933	-0.03302	0	0	0	1.51749	[cm]
29.63297	0.55087	0	0	0	-0.12864	[mrad]
0	0	3.4684	-0.29538	0	0	[cm]
0	0	24.32144	-1.783	0	0	[mrad]
4.49728	0.08317	0	0	1	-1.20456	[cm]
0	0	0	0	0	1	[%]
/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]	

^{20}Ne (23.7 MeV/u); Settings on ^{20}Ne; Config: SSSSSSDDSSMMMMMMM
dp/p=15.82% ; Brho(Tm): 1.4084, 1.4084



Configurations : “eMSP144_b.lpp” file

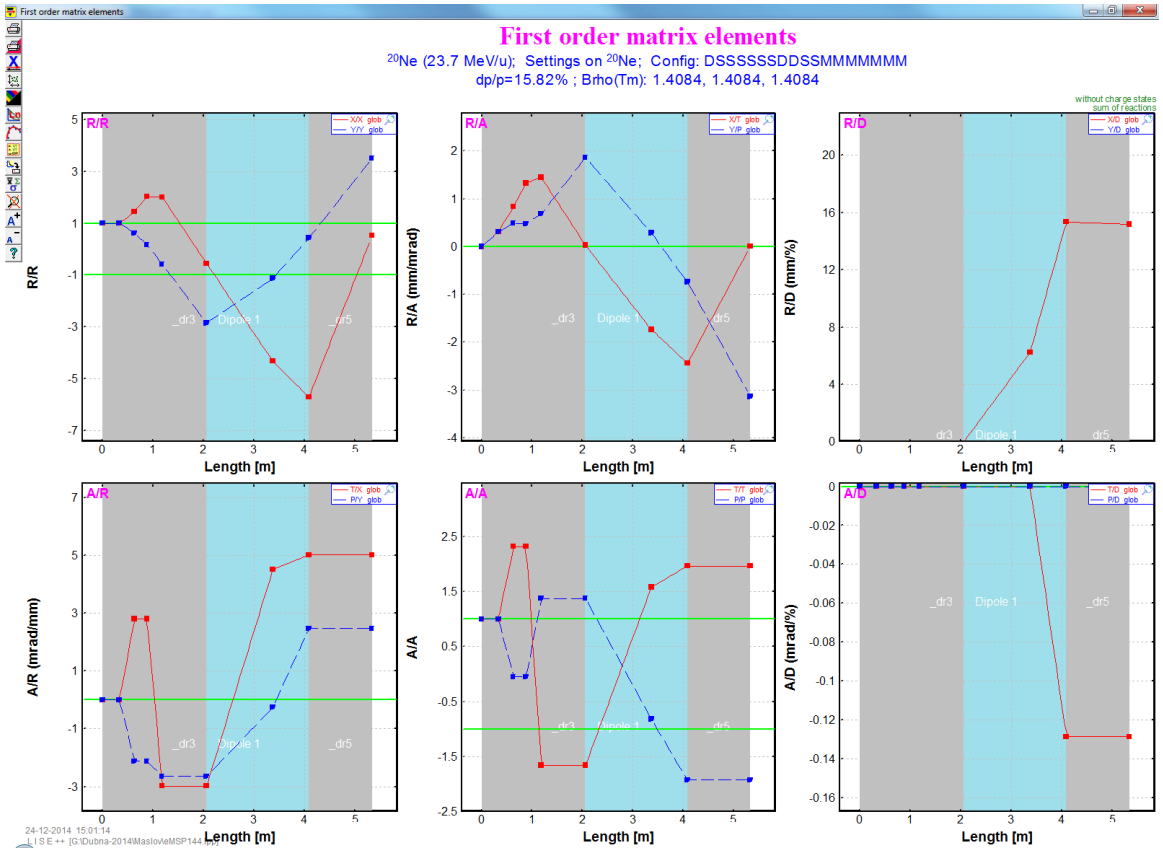
	effective	iron	delta	fileds	Quad-eff coef
drift	312.75	332			
quad1	338.5	300	19.25	-0.56	0.700
drift	211.5	250			
quad2	338.5	300	19.25	**0.603**	0.700
drift	858.75	878			
D1	g/2	2.35	cm		
D2	g/2	1.5	cm		
drift	1470				
Here is zero X-focus					

Changed according to the original MSP144 information

LISE++

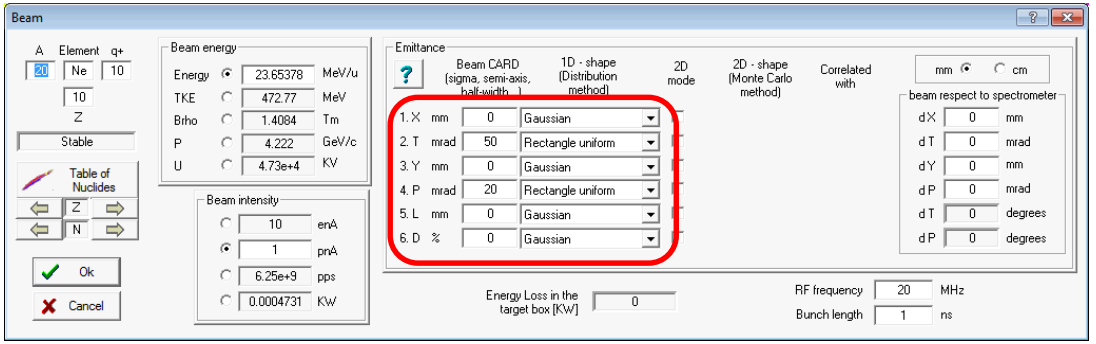
Global matrix

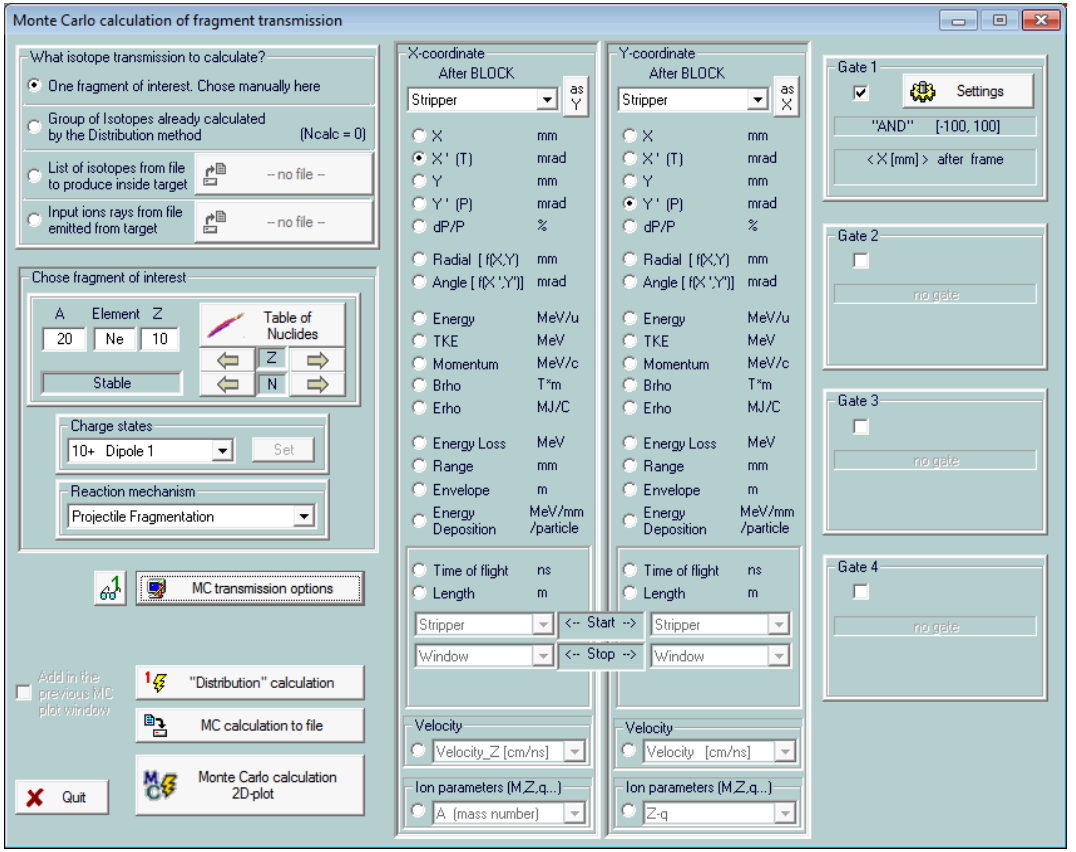
0.5166	-0.00016	0	0	0	1.51749	[cm]
49.51072	1.92071	0	0	0	-0.12865	[mrad]
0	0	3.51039	-0.31344	0	0	[cm]
0	0	24.68305	-1.91904	0	0	[mrad]
7.51983	0.29146	0	0	1	-1.20456	[cm]
0	0	0	0	0	1	[%]



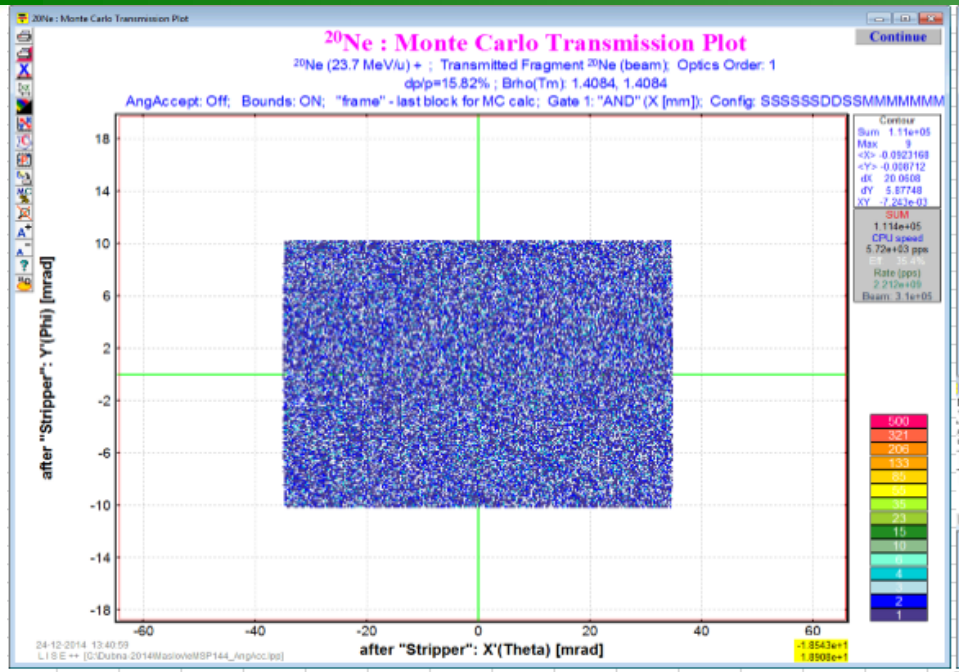
Settings for Angular Acceptance study

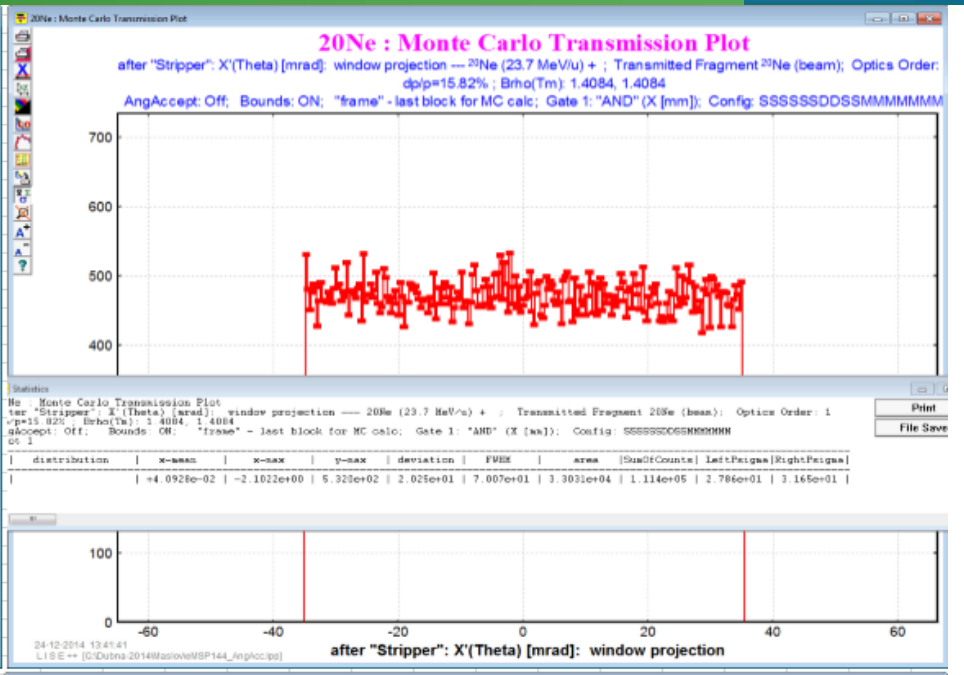
file
"eMSP144_AngAcc.lpp"





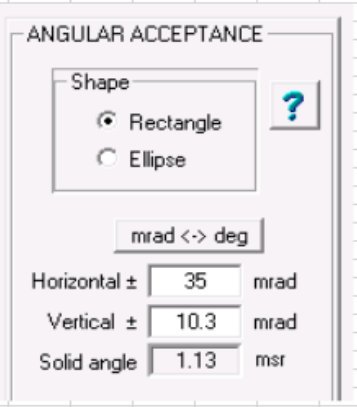
Angular Acceptance : 1st order

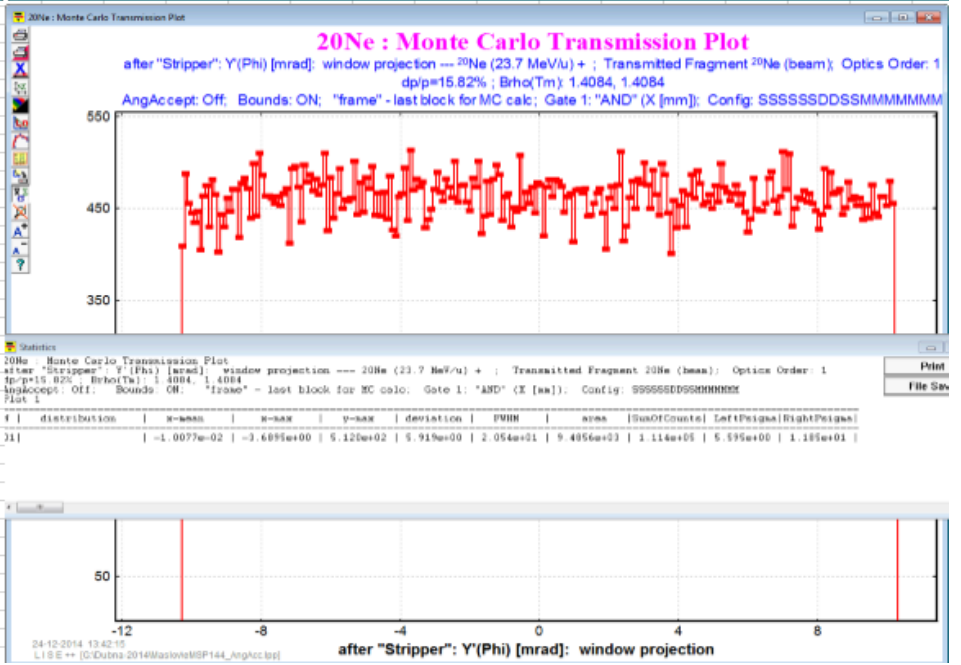




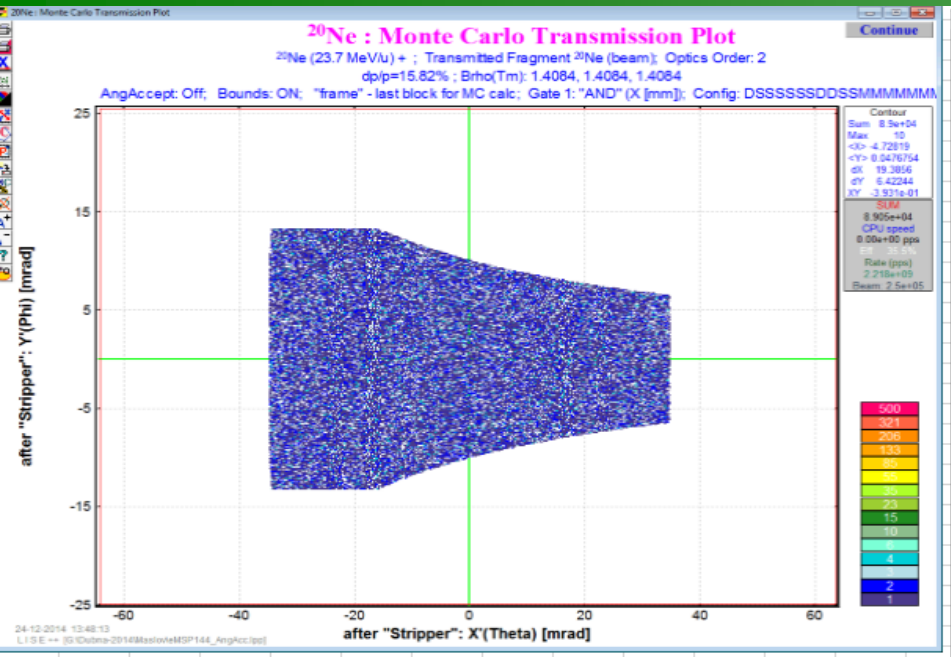
CUTS

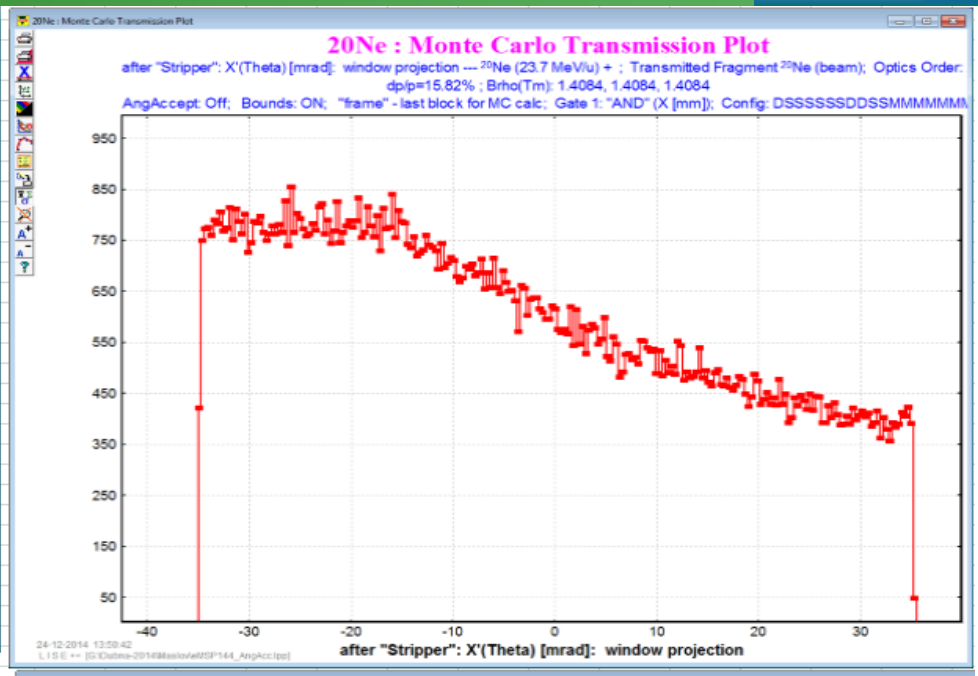
Global Transmission	
Target	
_dr1	100.0%
Quad1	100.0%
_dr2	82.04%
Inside of bounds	82.04%
Quad2	84.10%
Inside of bounds	84.10%
_dr3	100.0%
_dr3a	100.0%
Dipole 1	65.97%
Inside of bounds	65.97%
Dipole 2	100.0%
_dr5	100.0%
frame	77.48%
Slits	77.48%





Angular Acceptance : 2nd order

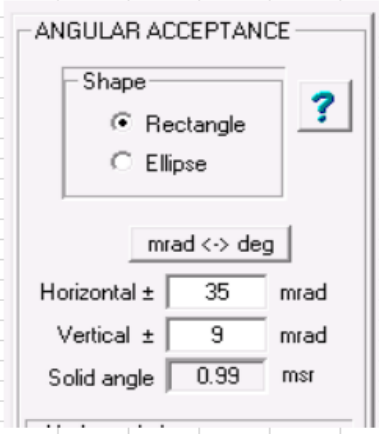


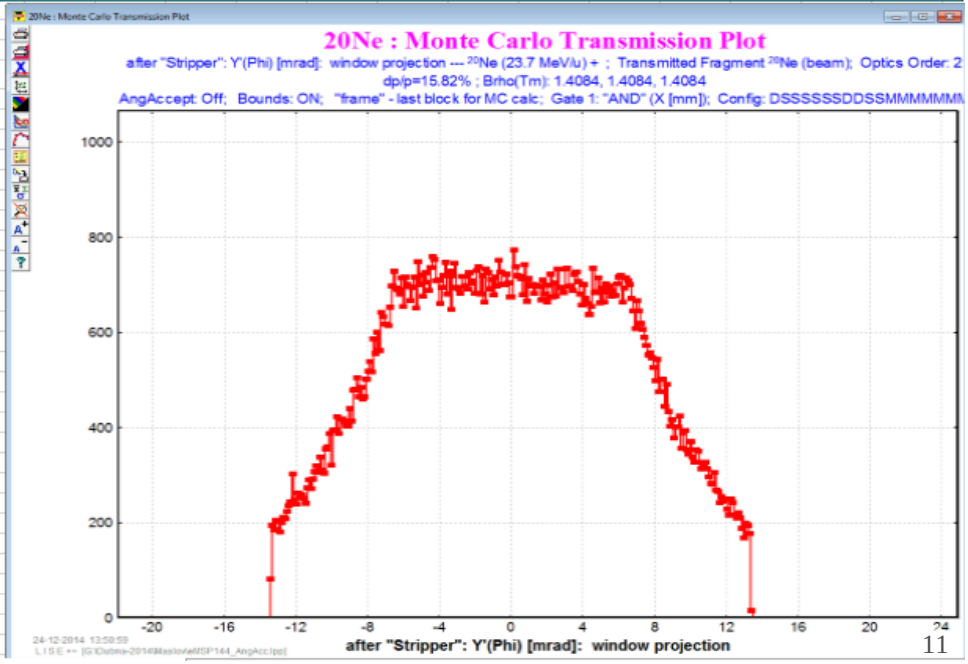


CUTS

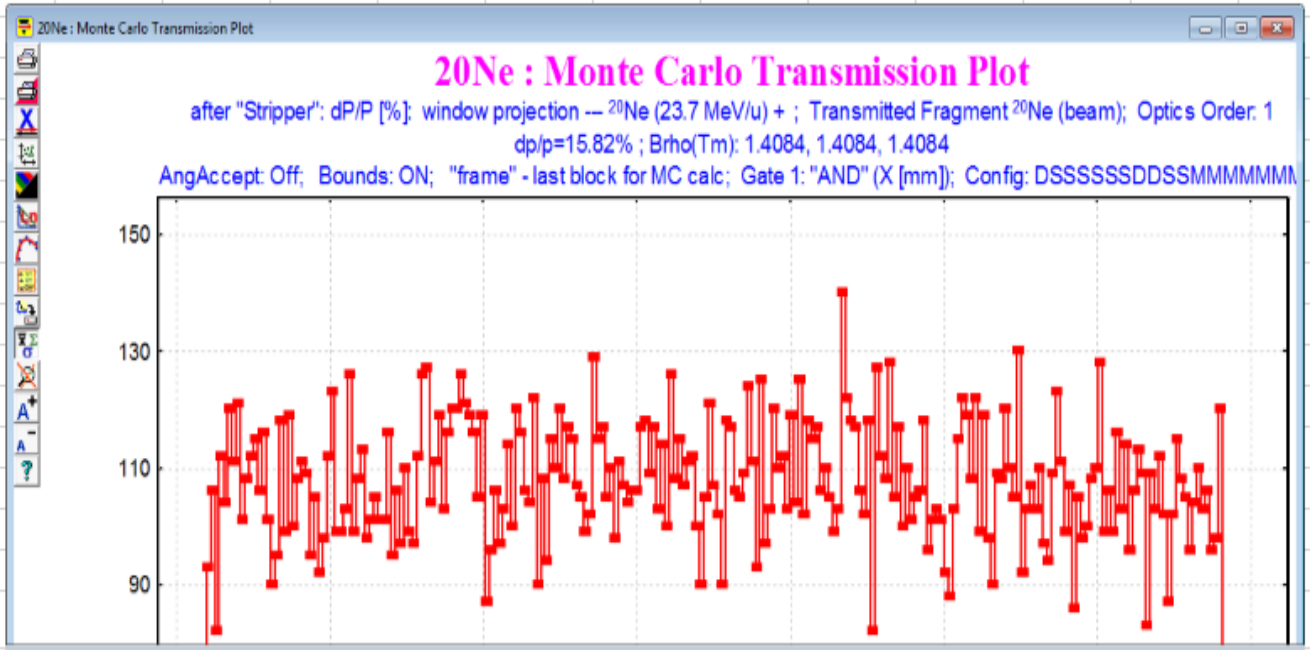
Global Transmission	
Target	
tuning	100.0%
_dr1	100.0%
Quad1	100.0%
_dr2	82.29%
Inside of bounds	82.29%
Quad2	83.95%
Inside of bounds	83.95%
_dr3	100.0%
_dr3a	100.0%
Dipole 1	66.55%
Inside of bounds	66.55%
Dipole 2	98.70%
Slits	98.70%
_dr5	98.66%
Inside of bounds	98.66%
frame	79.58%
Slits	79.58%
Filter-gate 1	100.0%

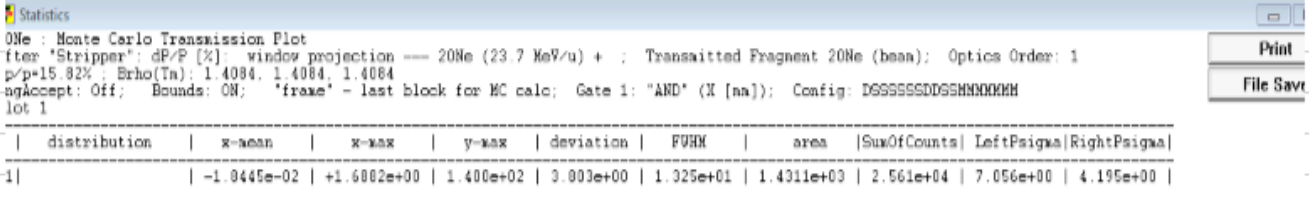
RECOMMENDED

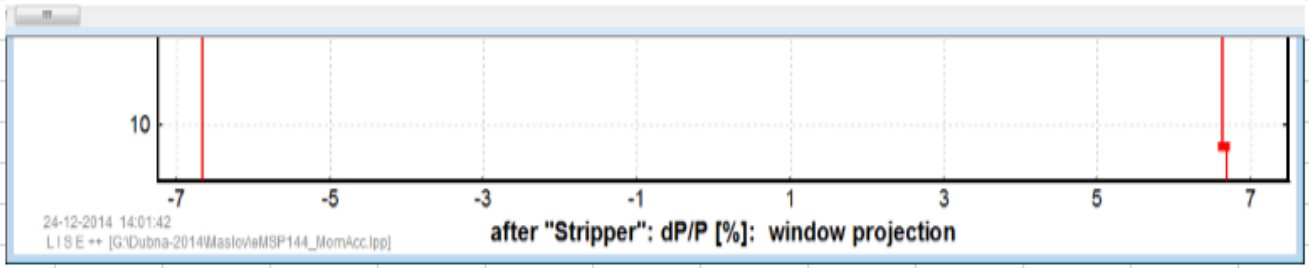


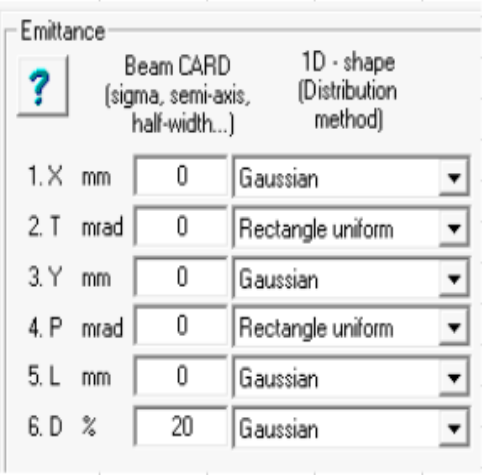


Momentum Acceptance





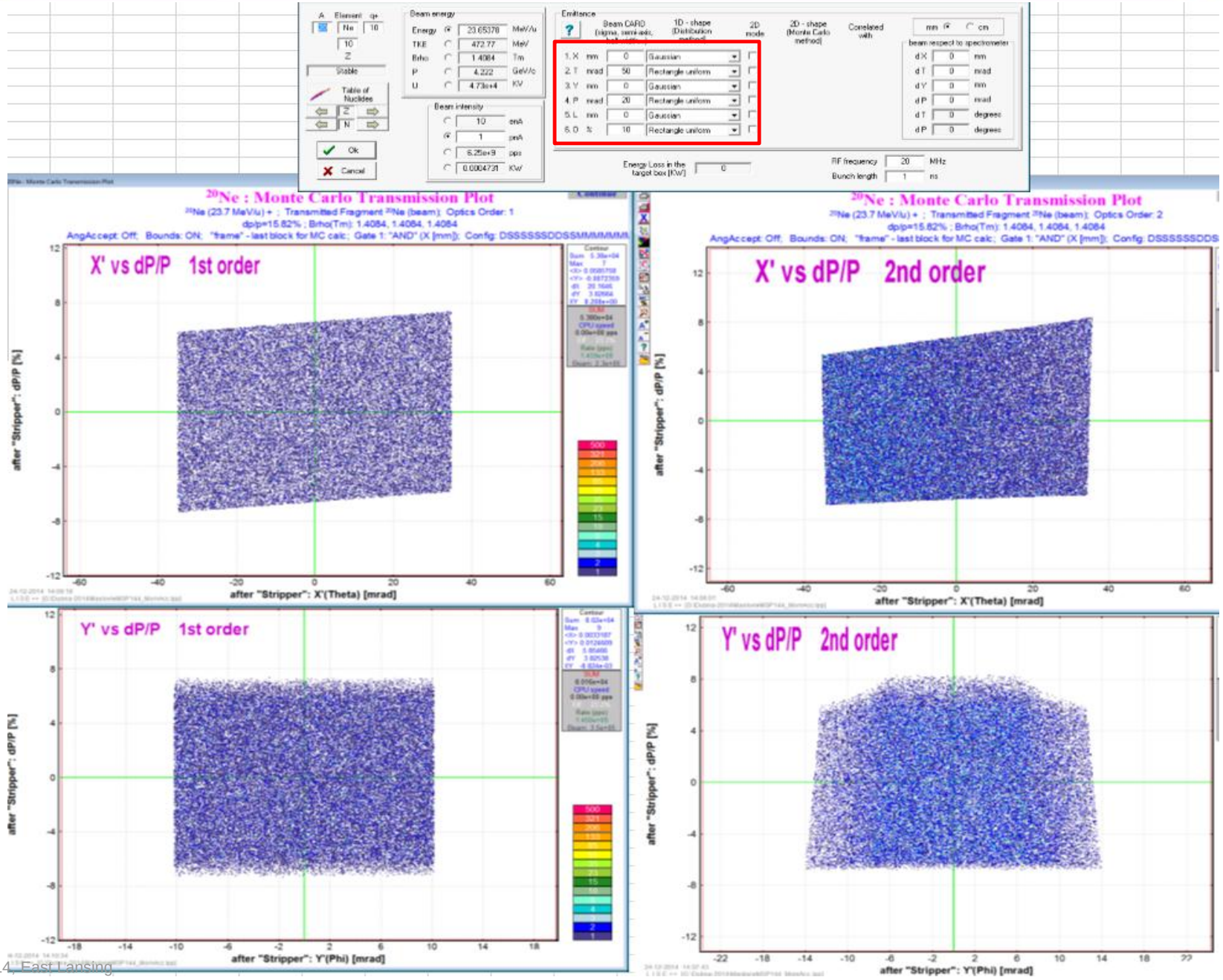




in the current configuration is defined by rhe Ionization chamber size

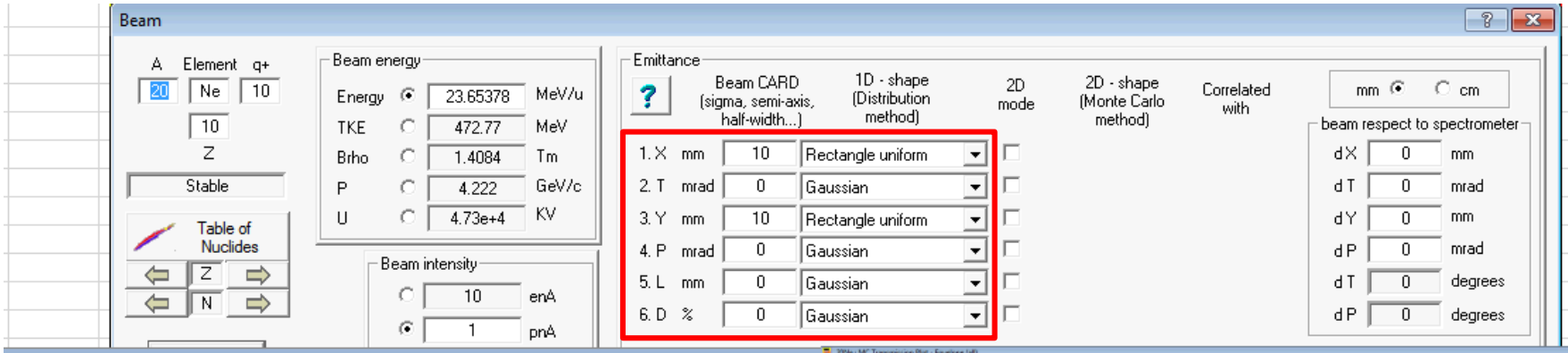
dP/P = 13.25 % (total)

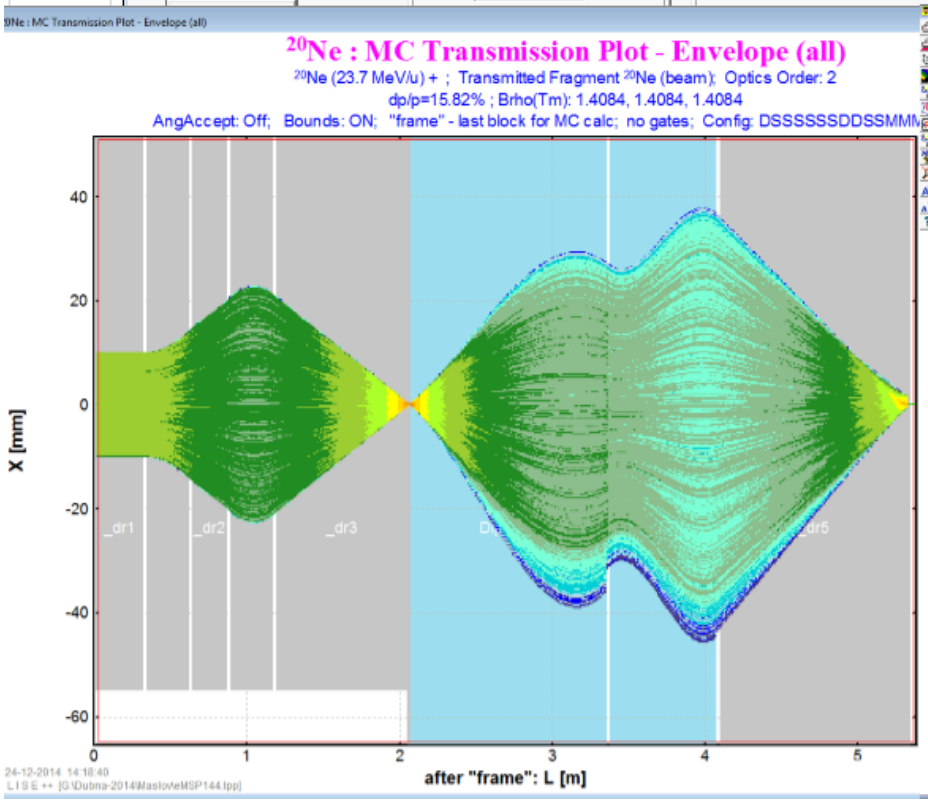
Momentum & Angular Acceptance

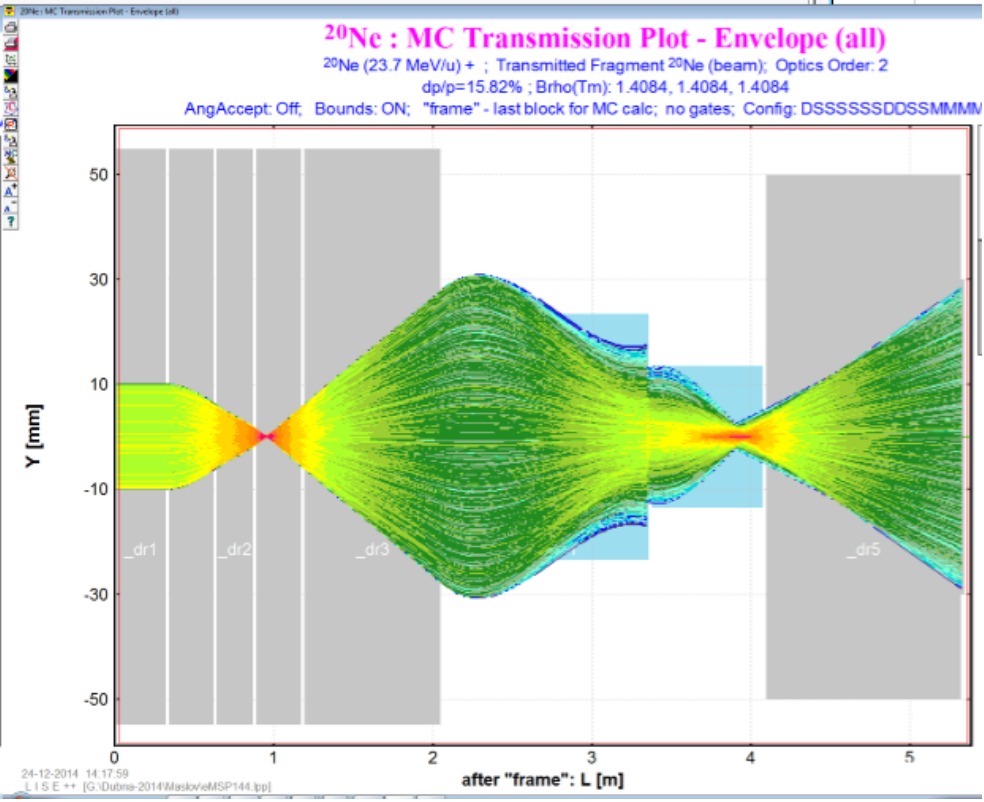


Envelopes : emittance X & Y (2nd order)

"eMSP144_a.lpp"

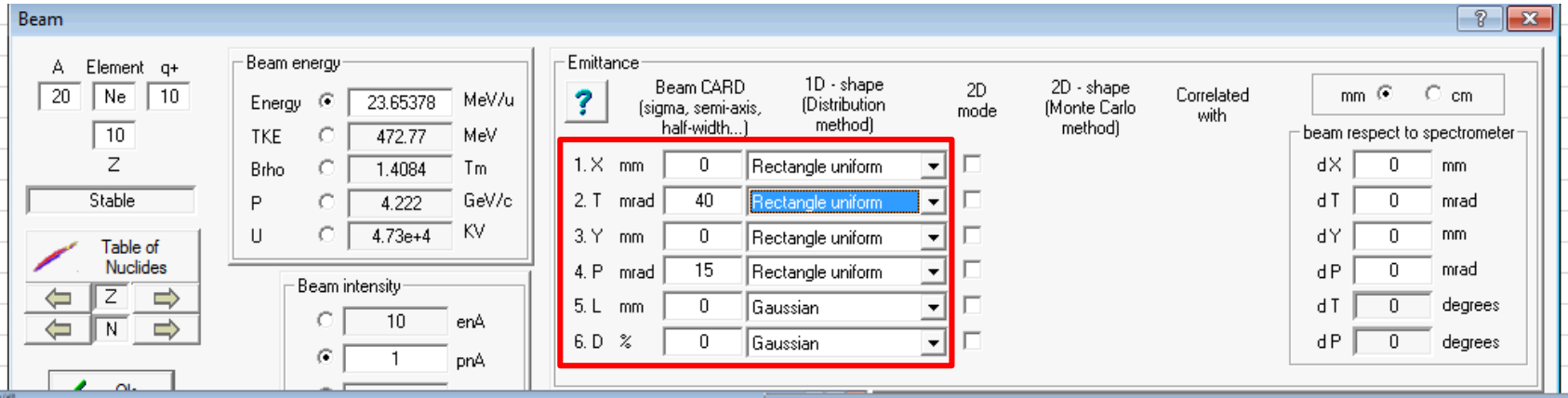


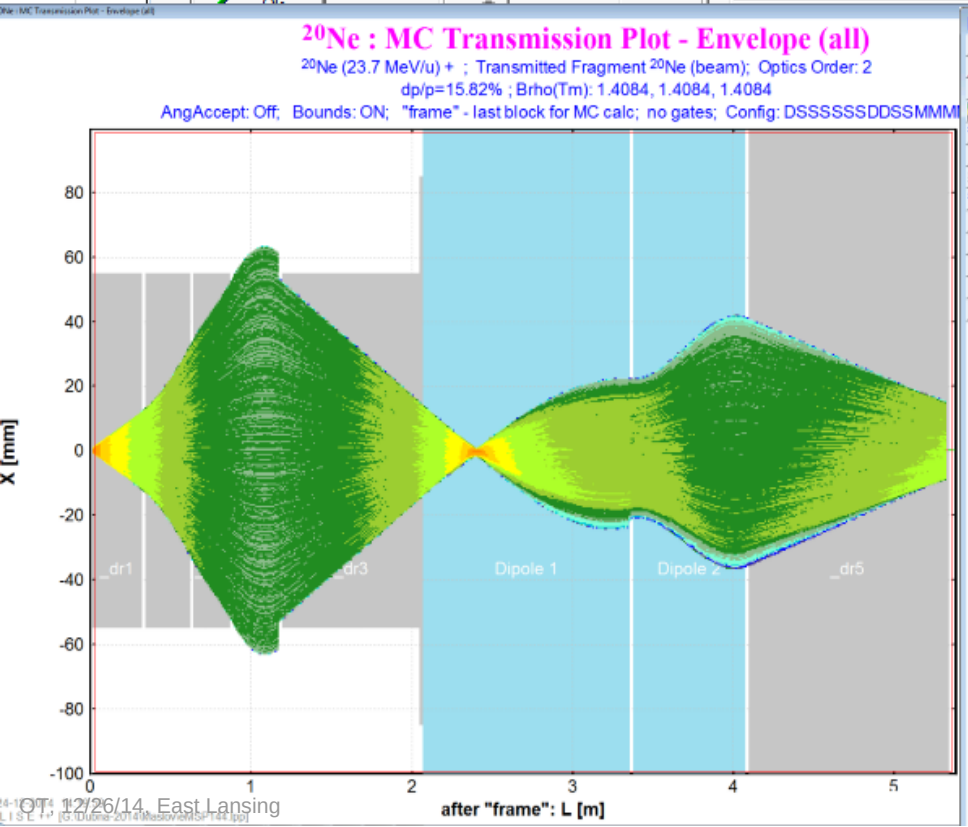


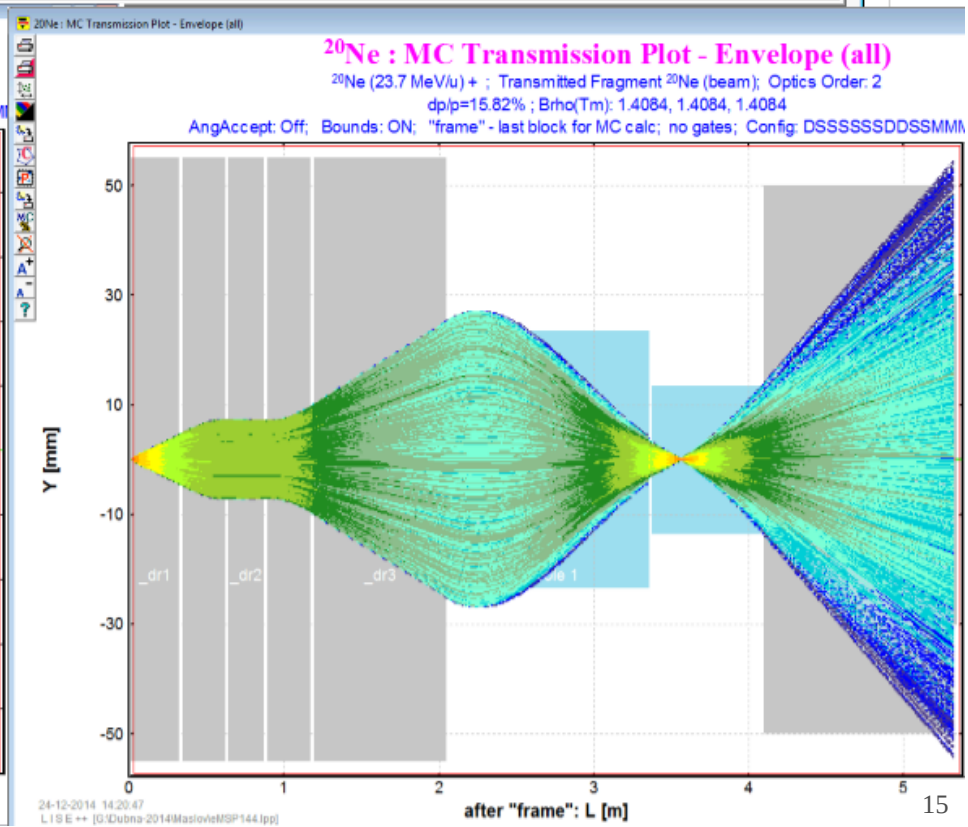


Envelopes : emittance X' & Y' (2nd order)

"eMSP144_a.lpp"

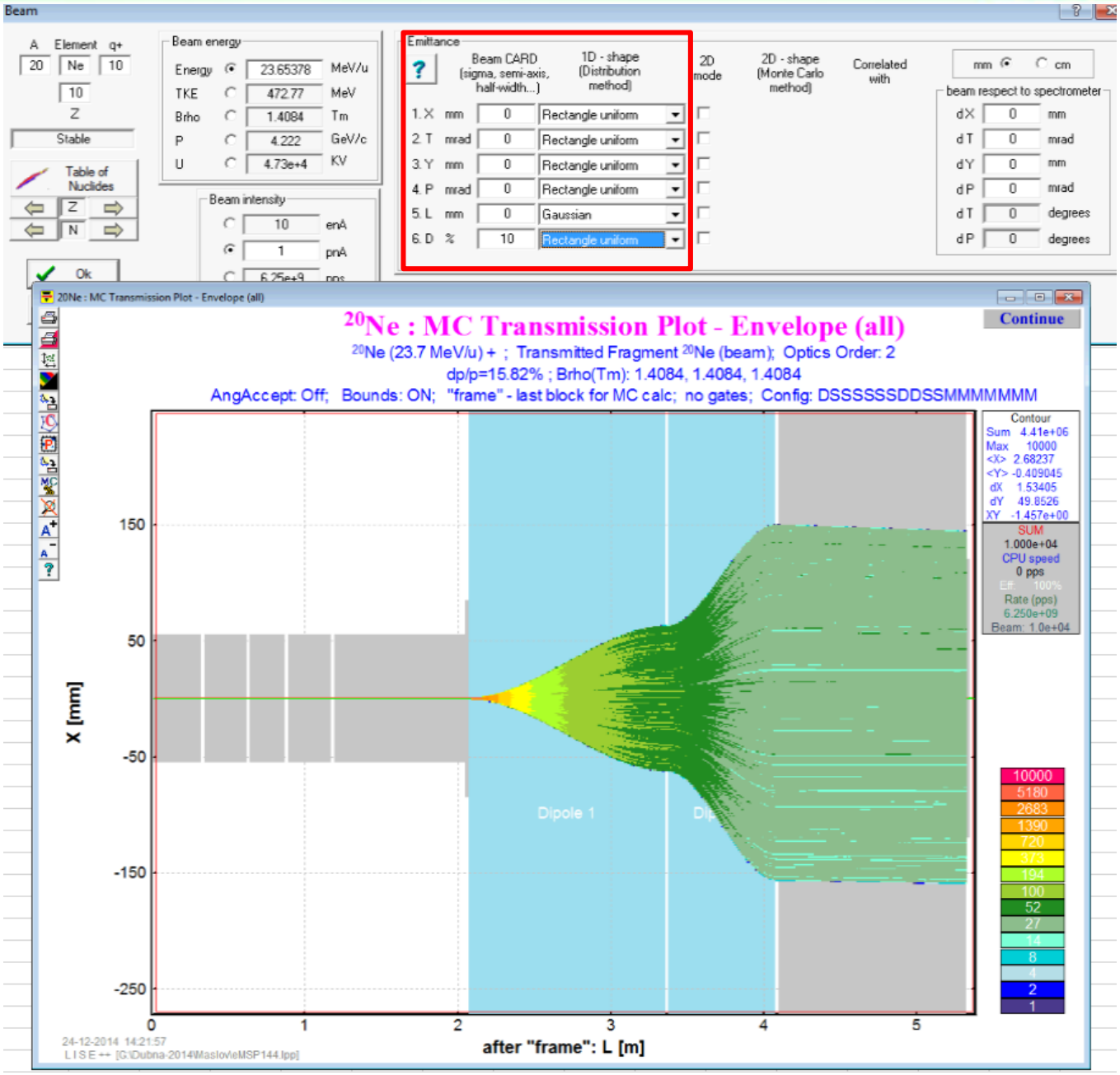




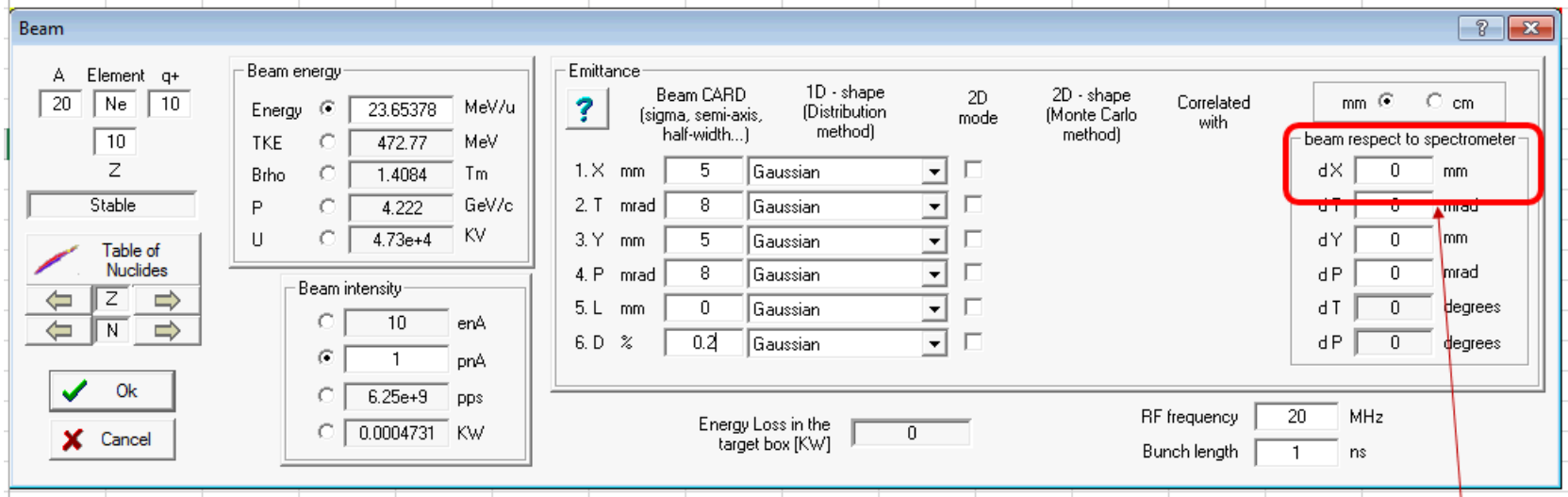


Envelopes : emittance dP (2nd order)

"eMSP144_a.lpp"



Turn of MSP-144 spectrometer



1. Диаметр пучка — 10 мм.
2. Эмиттанс пучка — $\varepsilon_x = \varepsilon_y$ = 40 -60 π мм мрад.

use this cell to "turn" separator relatively the primary beam