Blocks: E-quad, E-bender, Shift

This update can be used to create DRAGON, FMA, S^3 and others extended configurations, where E-quads and E-dipoles are used

V. 9.6.117
from 08/06/13

1. Electrostatic quadrupole

** matrix calculation*

2. Electrostatic bender (dipole) update

** matrix calculation*
** $E\rho$ selection for analytical and MC calculations*
** E & B bends example*
** D-line : extended configuration*

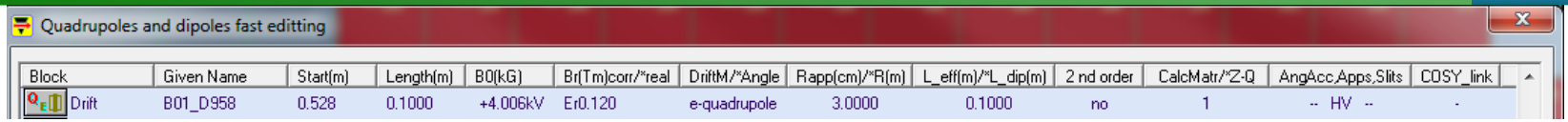
3. New optical block : "Shift"

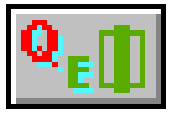
** example with 5 mm 1st triplet misalignment*

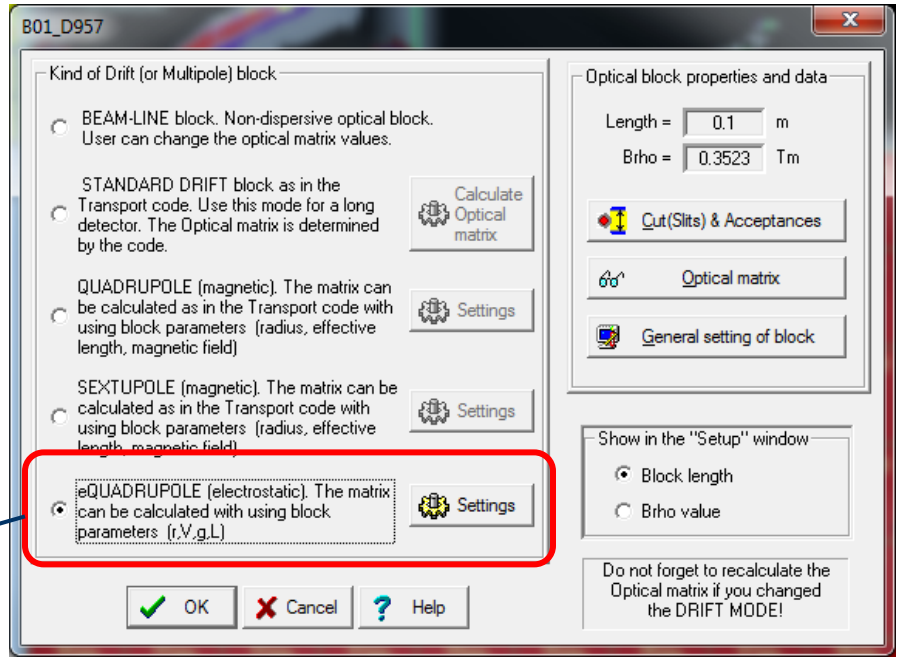
4. Others (July-August 2013)

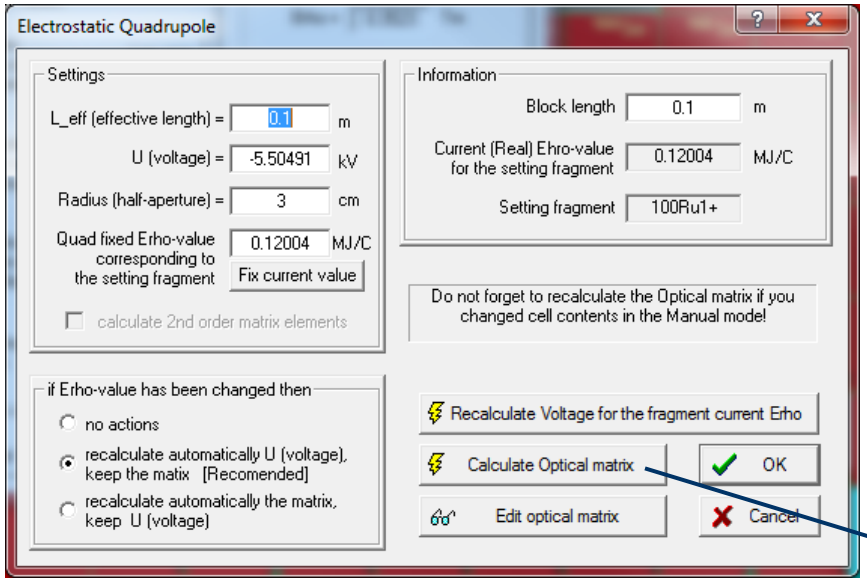
The code operates under MS Windows environment and provides a highly user-friendly interface.
It can be freely downloaded from the following internet addresses:
http://lise.nscl.msu.edu

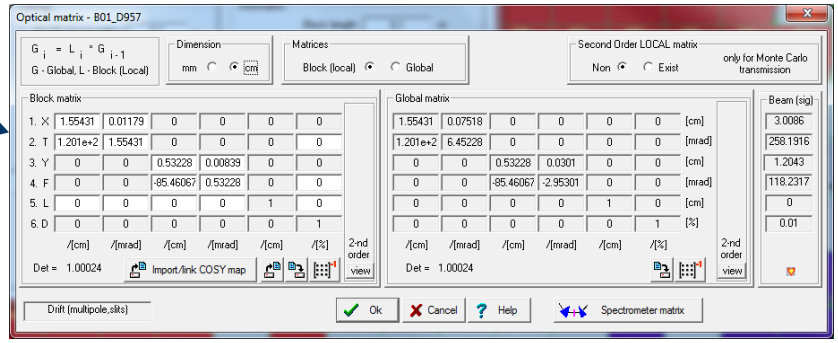
1. Electrostatic quadrupole









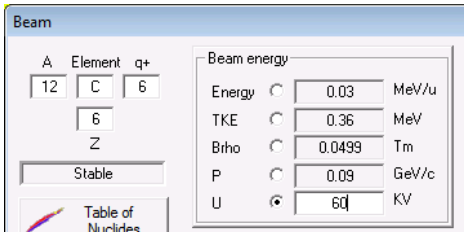


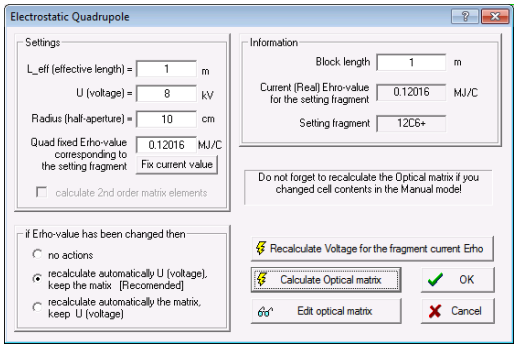
Right now it is only 1-st order calculations

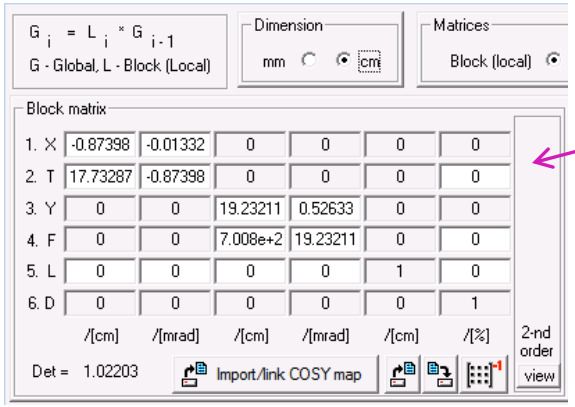
E-quad -- options : matrix keeping & automatic U recalculation, and U-keeping & automatic matrix recalculation

1.1 Electrostatic quadrupole: LISE^{++} vs. COSY

LISE^{++}



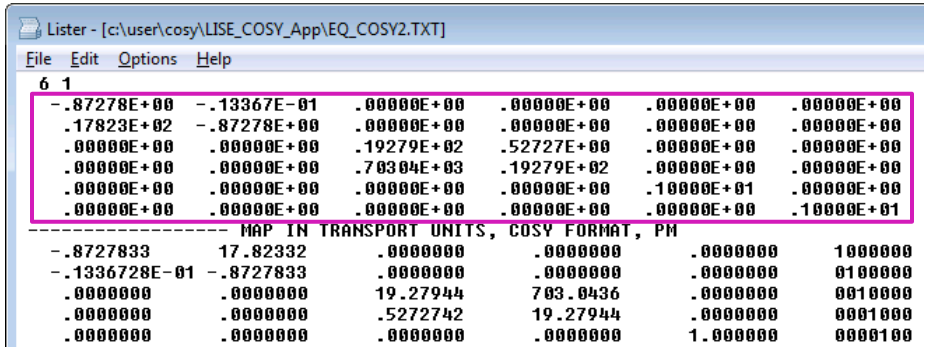




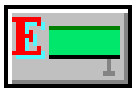
COSY

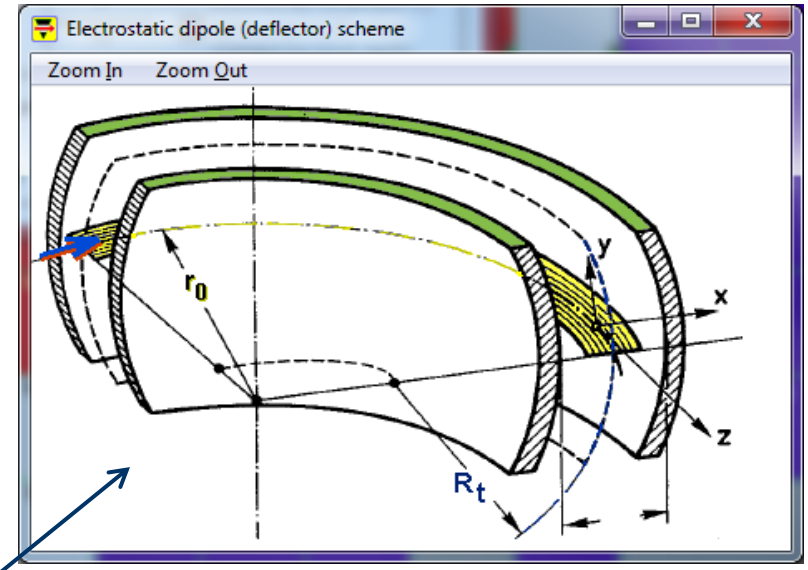
EQ <length> <voltage at pole tip> <aperture> ;

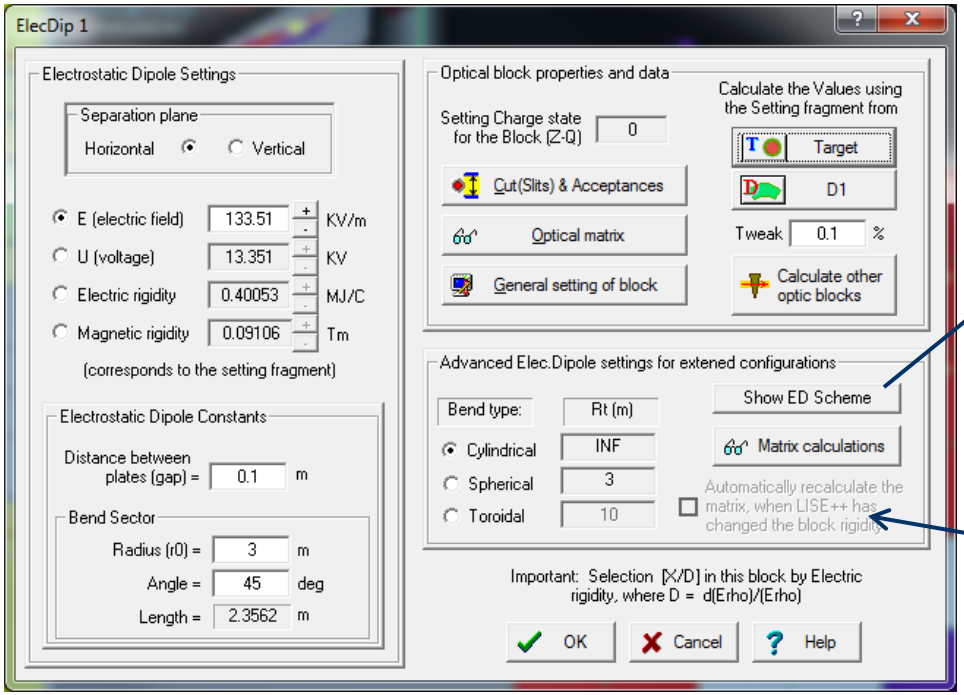
```
A := 12 ;
Q := 6 ;
VACC_0 := 0.060 ;   {Acceleration energy 60 KV}
 UM;
    EQ 1.00 8.0 0.1;
PM_LISE 'EQ_COSY.TXT';
```



2. Electrostatic bender (dipole)



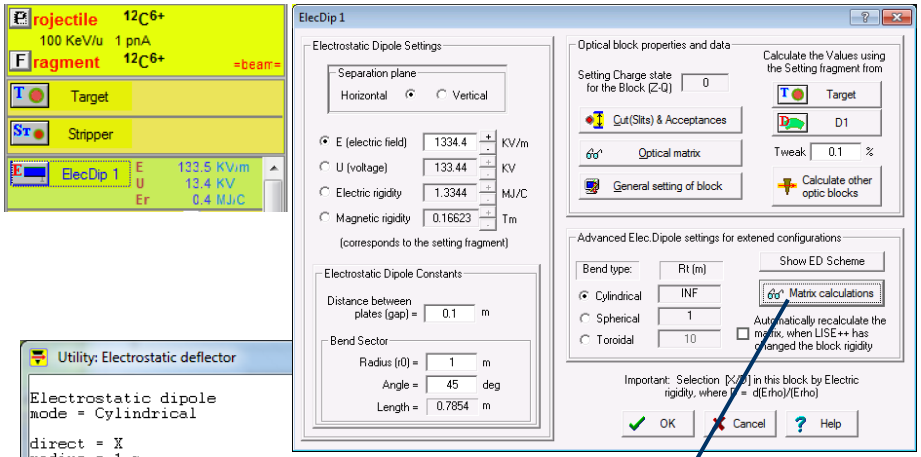


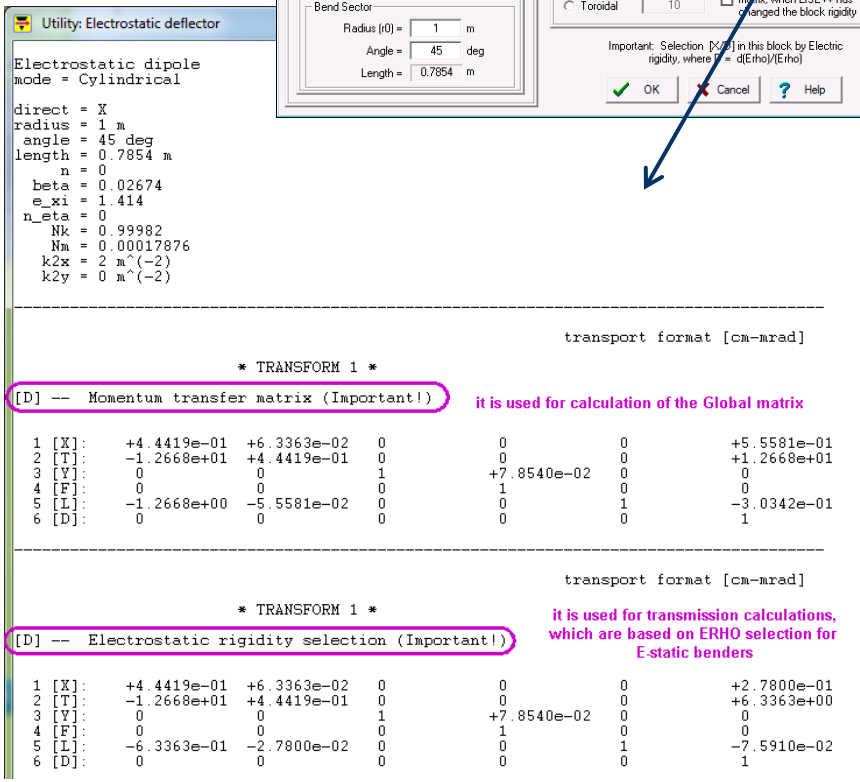


This checkbox is available after matrix calculations done

2.1 Electrostatic bender (dipole) : LISE++ vs. COSY

LISE++

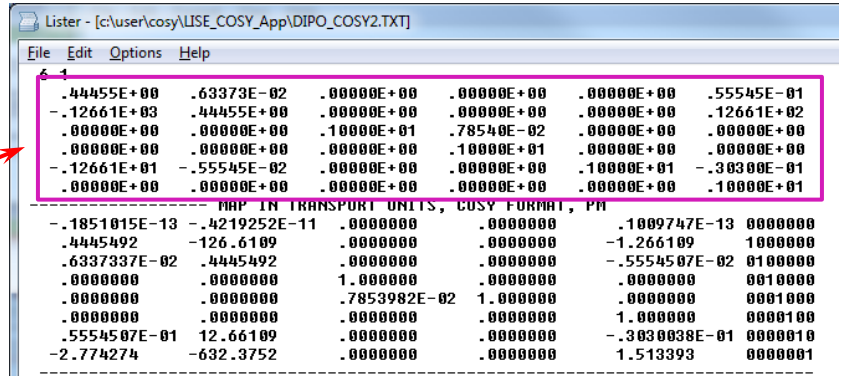




COSY

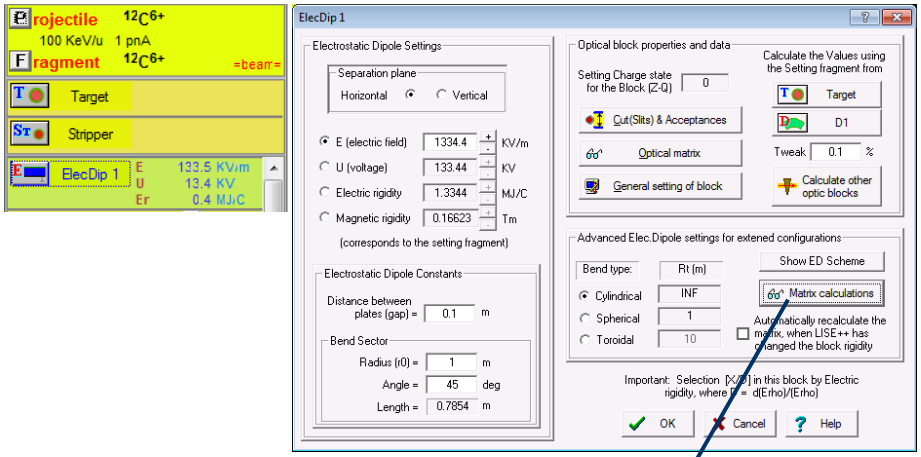
```
ES <radius> <angle> <aperture>
 < n1 >< n2 >< n3 >< n4 >< n5 >;
```

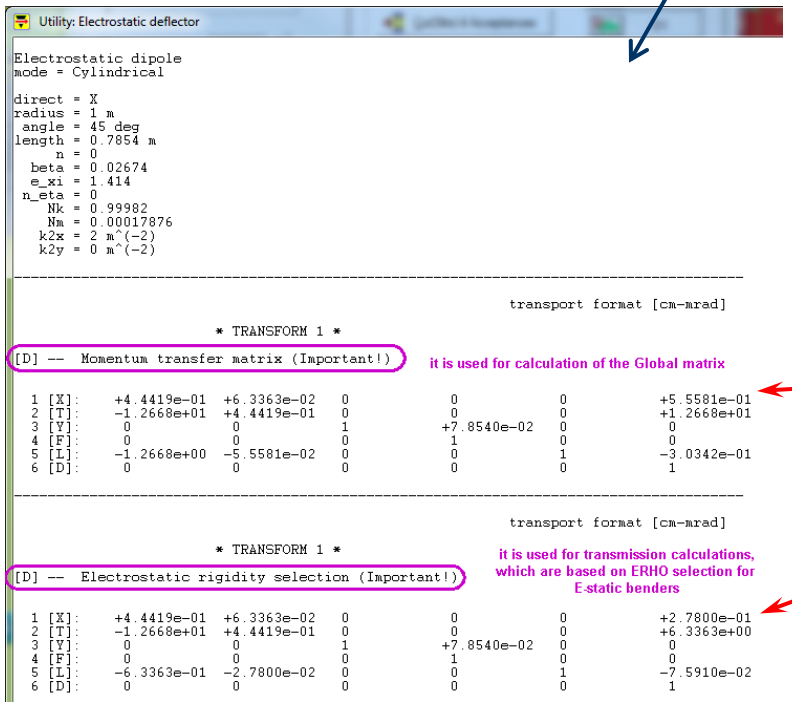
```
A_0 := 12 ;
Q_0 := 6 ;
 RP 12. A_0 Q_0 ;

  UM;
  ES 0.1 45.0 0.05 1 -1 1 -1 1;
  PM_LISE 'DIPO_COSY2.TXT';
```



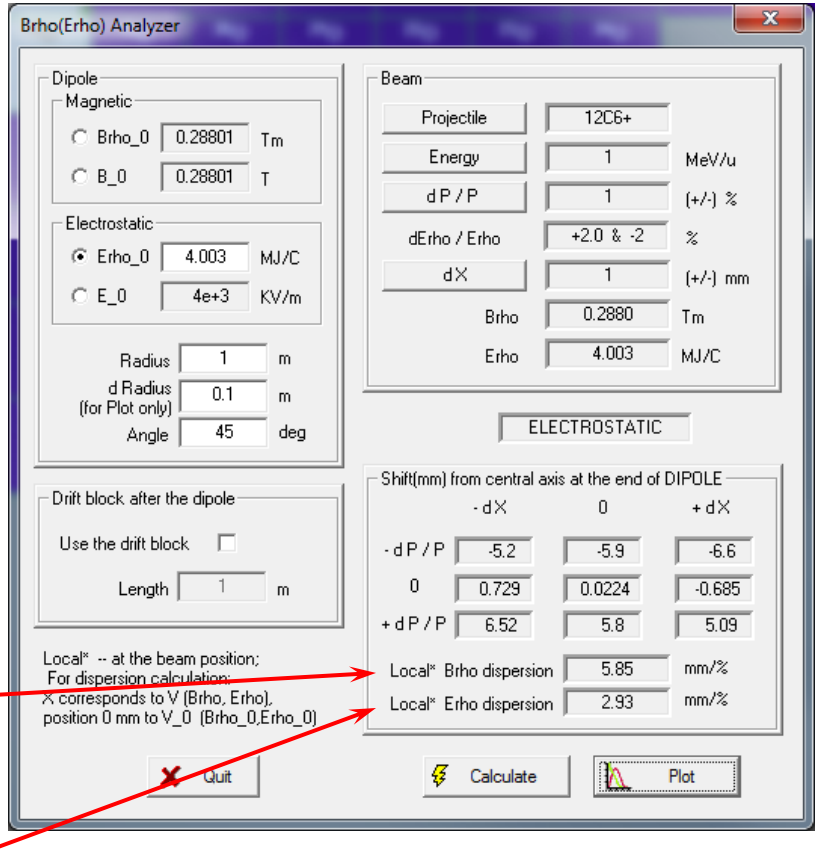
2.2 Electrostatic bender (dipole) vs. Bρ(Eρ) Analyzer

LISE++



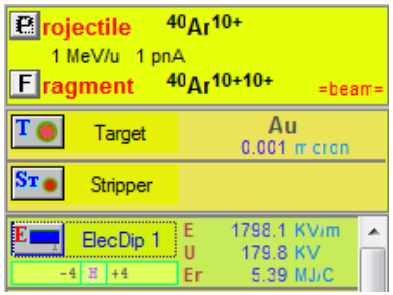


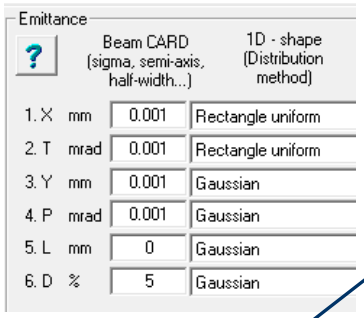
Bρ(Eρ) Analyzer

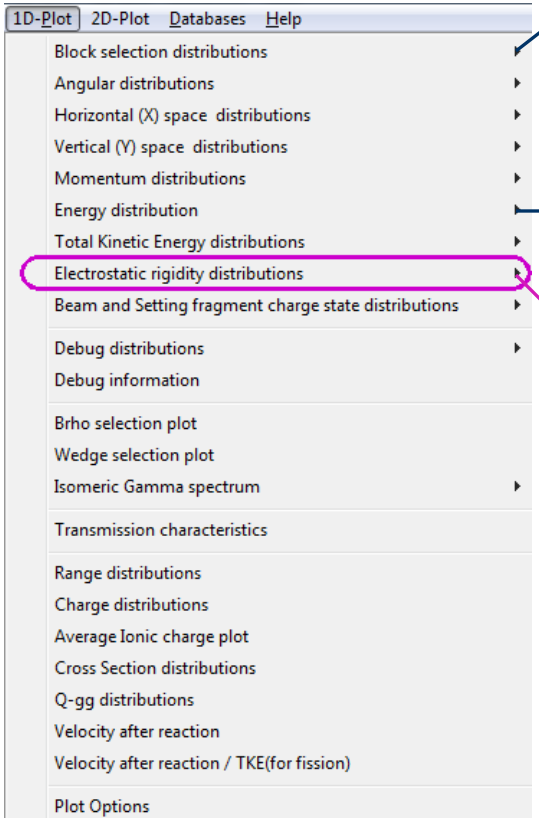


2.3 New feature in LISE^{++} : Eρ selection

Initial conditions



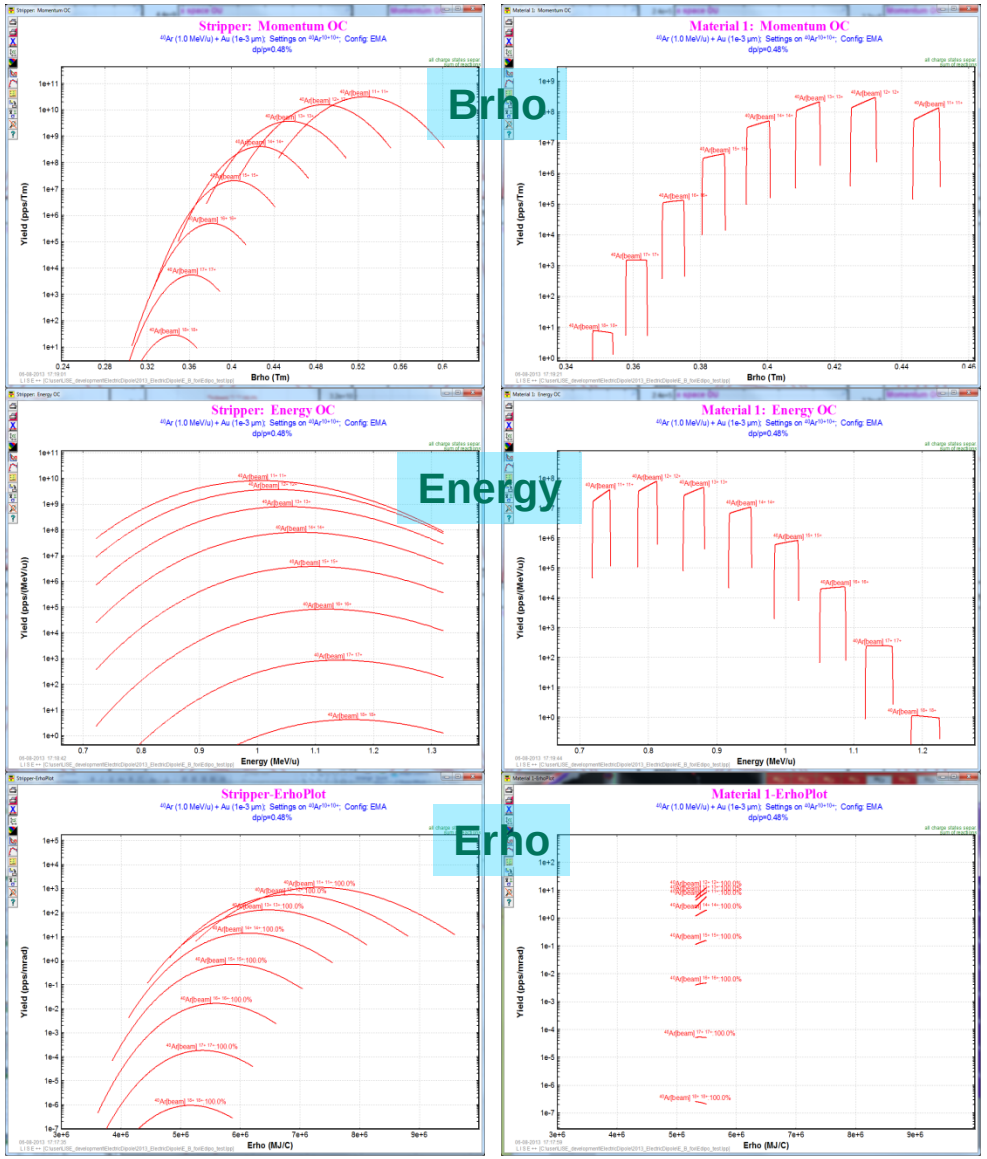




"Distribution" solution

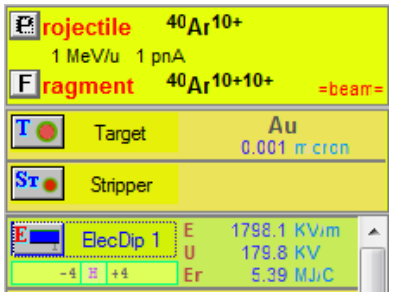
after target

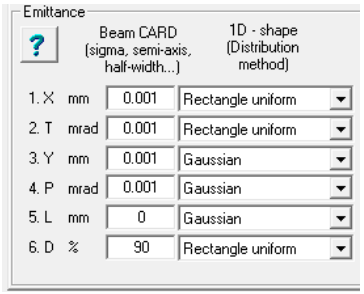
after the E-dipole with ± 4 mm slits

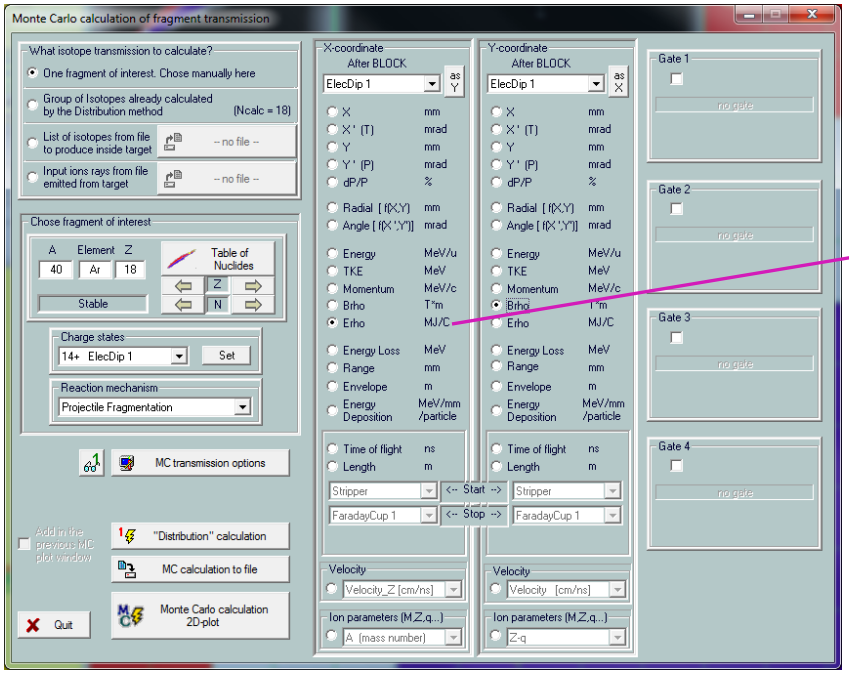


2.3 New feature in LISE^{++} : Eρ selection

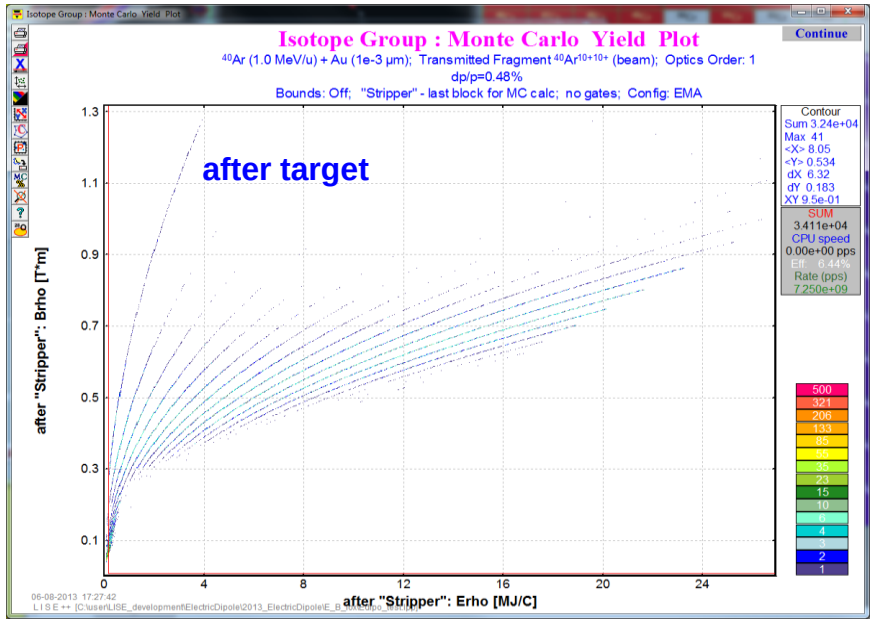
Initial conditions

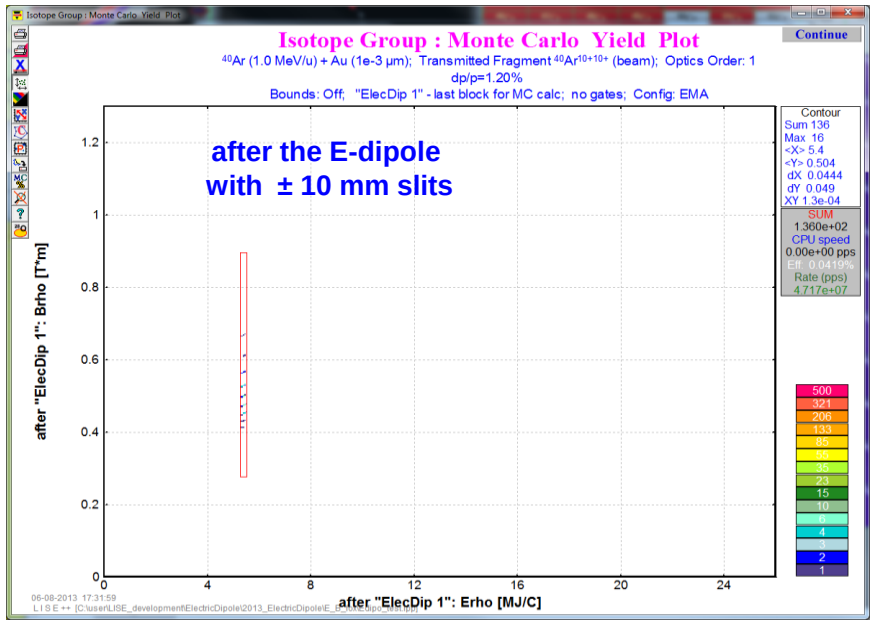






MC solution





2.4 E & B bends example

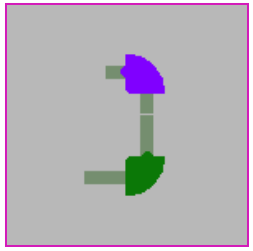
http://lise.nscl.msu.edu/9_6/Edipole/EB_case.lpp

MM.Portillo's example, and COSY calculations

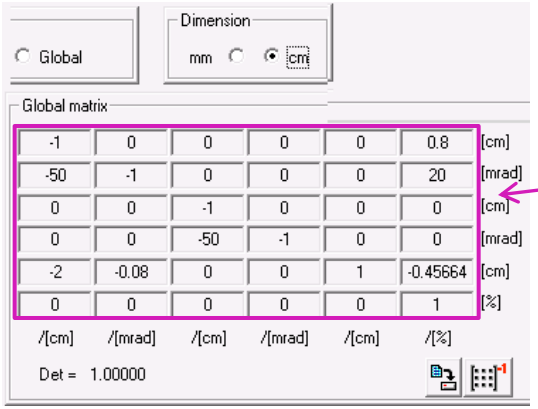
Purpose

- Create an energy achromat system
  - Using double focusing
  - E-dipole
    - » Bend of 90deg at R=0.2 m spherical electrodes for equal x- and y-focus strength
    - » Drift before and after bend = R
  - B-dipole
    - » Bend of 90deg at R=0.2 m
    - » 26.56deg entranc & exit edge angles for equal x- and y-focus strength
    - » Drift before and after bend = 2R

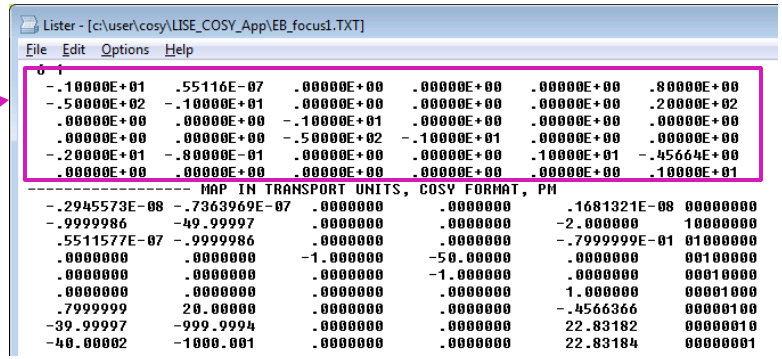
LISE++

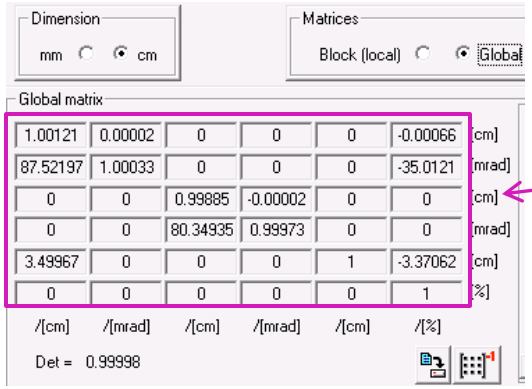


COSY

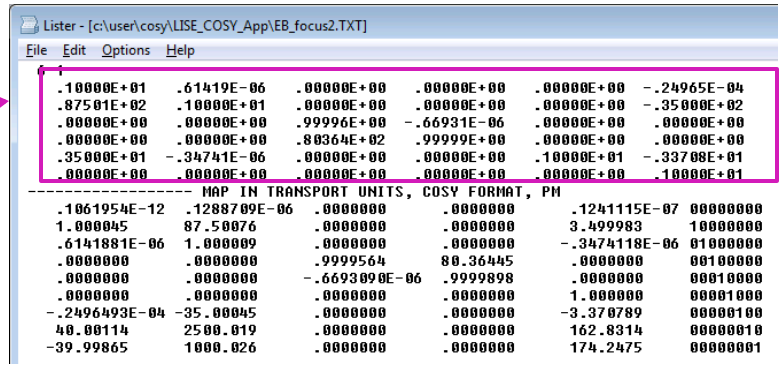


E bend focus





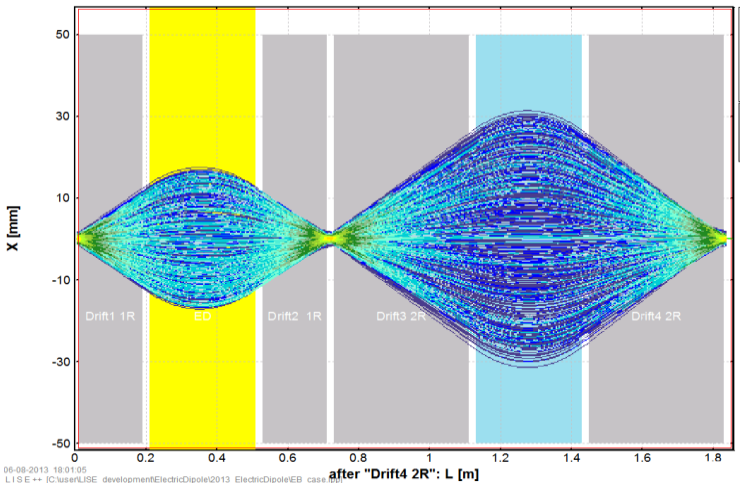
E + B bend focus

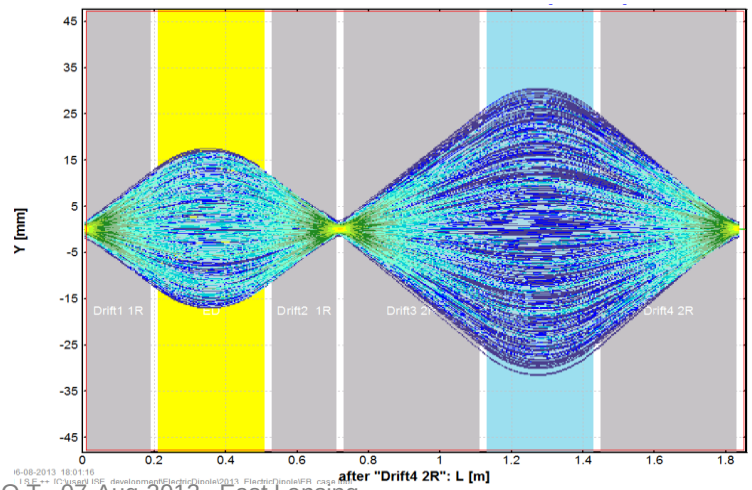


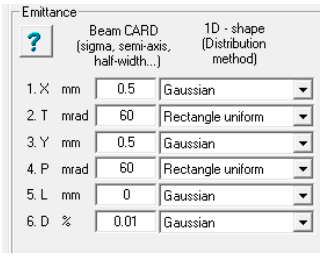
2.4 E & B bends example

http://lise.nscl.msu.edu/9_6/Edipole/EB_case.lpp

LISE++

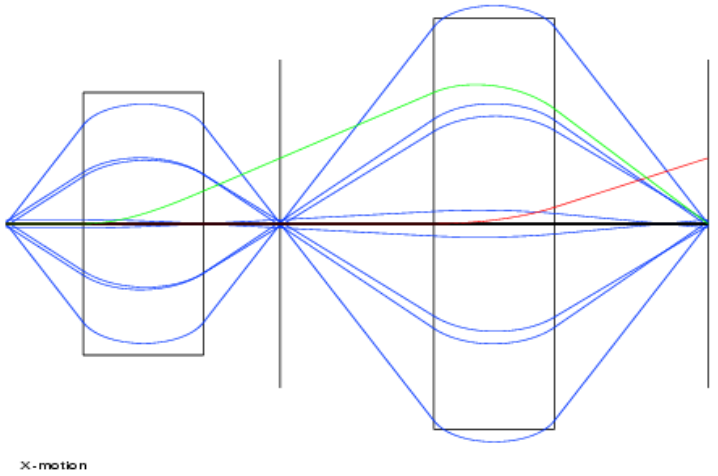


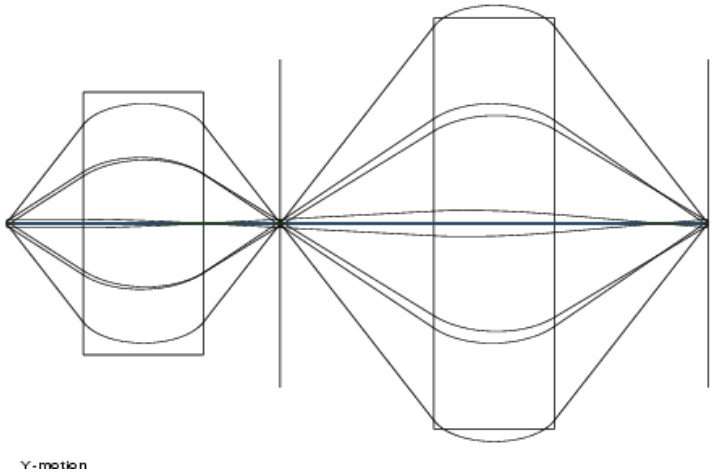




M.Portillo's example, and COSY calculations

COSY



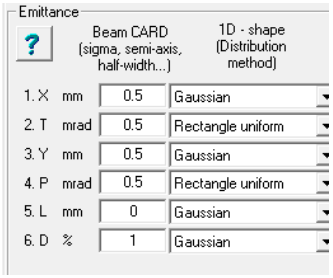


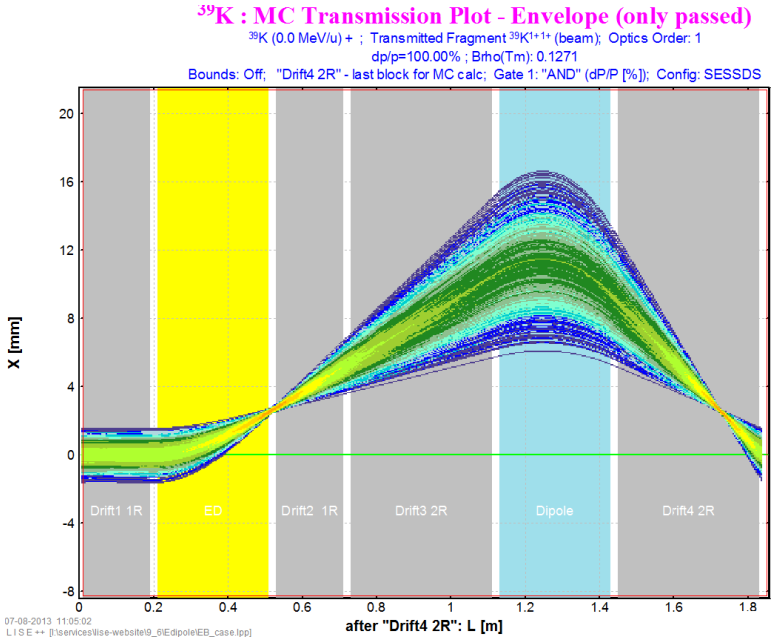
2.4 E & B bends example

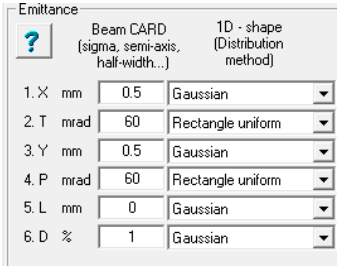
http://lise.nscl.msu.edu/9_6/Edipole/EB_case.lpp

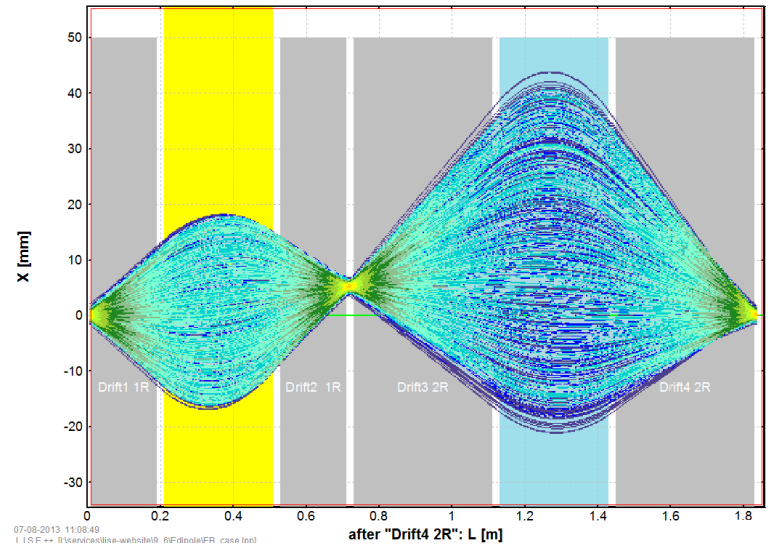
LISE++

M.Portillo's example, and COSY calculations









2.4 E & B bends example : TKE-dispersion

LISE++ file:

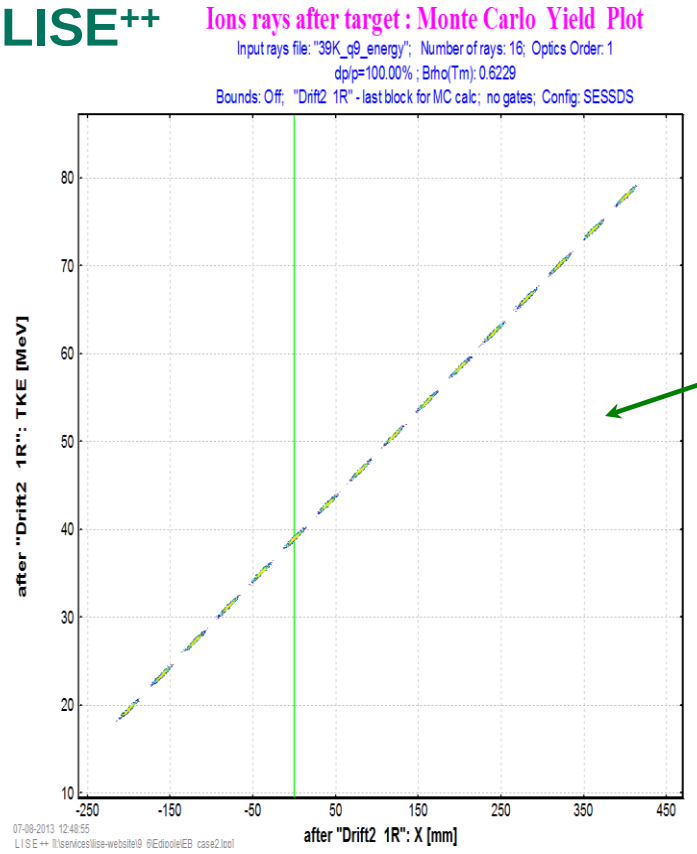
http://lise.nscl.msu.edu/9_6/Edipole/EB_case2.lpp

Input rays file:

http://lise.nscl.msu.edu/9_6/Edipole/39K_q9_energy.inrays

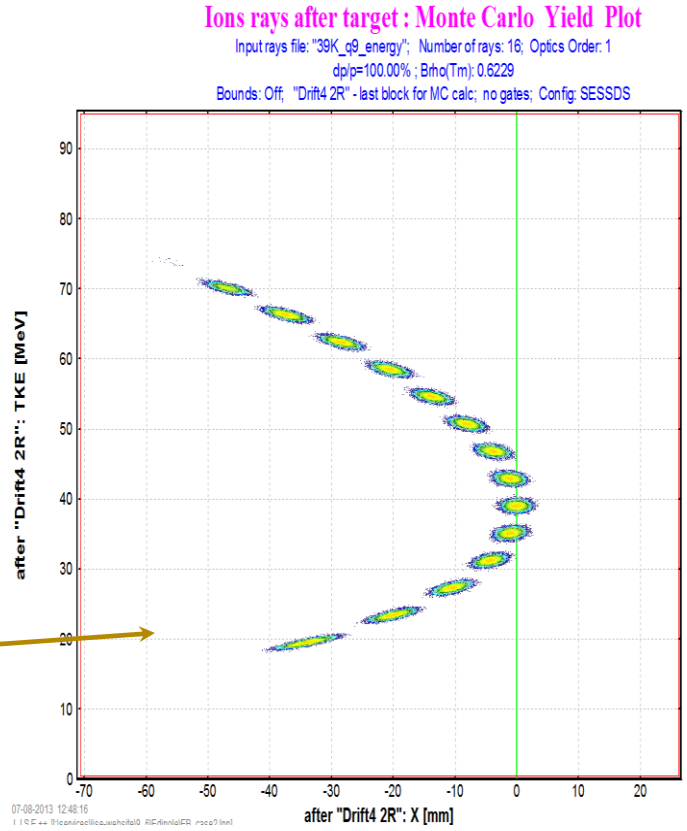
! 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
! Z	N	q	X	d(X)	X'	d(X')	Y	d(Y)	Y'	d(Y')	E	d(E)	t	d(t)
!			mm	mm	mrad	mrad	mm	mm	mrad	mrad	MeV/u	MeV/u	ns	ns
19	20	9	0	1	0	60	0	1	0	60	0.5	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	0.6	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	0.7	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	0.8	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	0.9	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.1	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.2	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.3	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.4	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.5	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.6	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.7	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.8	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	1.9	0.01	0	1
19	20	9	0	1	0	60	0	1	0	60	2	0.01	0	1

LISE++



COSY

```
E-BEND FOCUS
                                .P(
                  -0.9999986
                   0.5661256E-06
                   0.000000
                   0.000000
                   0.000000
(x,dE)1 →          0.4000000
(x,dM) 1 →         0.1101071E-06
(x,dQ) 1 →        -0.4000002
-----------------------------------

E+B BEND FOCUS
                   1.000045
                   0.6126912E-05
                   0.000000
                   0.000000
                   0.000000
(x,dE)2 →         -0.1248663E-04
(x,dM) 2 →         0.3999989
(x,dQ) 2 →        -0.3999865
-----------------------------------
(x,dM) 2=(x,dE) 1
(x,dE) 2=0
```



2.4 E & B bends example : M-dispersion

LISE++ file:

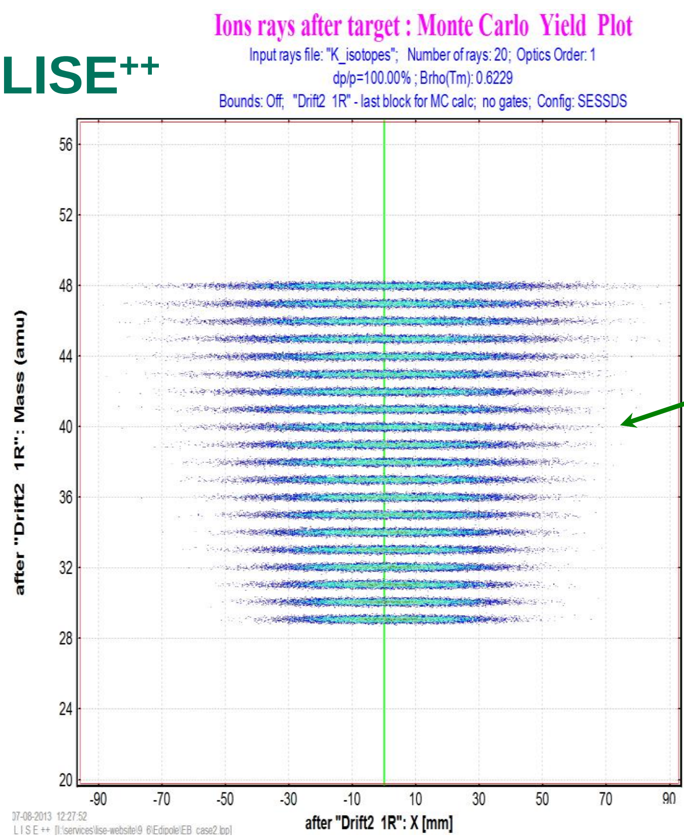
http://lise.nscl.msu.edu/9_6/Edipole/EB_case2.lpp

Input rays file:

http://lise.nscl.msu.edu/9_6/Edipole/K_isotopes.inrays

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	! 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	! Z	N	q	X	d(X)	X'	d(X')	Y	d(Y)	Y'	d(Y')	E	d(E)	t	d(t)
3	!			mm	mm	mrad	mrad	mm	mm	mrad	mrad	MeV/u	MeV/u	ns	ns
4	19	10	9	0	1	0	60	0	1	0	60	1.3448	0.05	0	1
5	19	11	9	0	1	0	60	0	1	0	60	1.3000	0.05	0	1
6	19	12	9	0	1	0	60	0	1	0	60	1.2581	0.05	0	1
7	19	13	9	0	1	0	60	0	1	0	60	1.2188	0.05	0	1
8	19	14	9	0	1	0	60	0	1	0	60	1.1818	0.05	0	1
9	19	15	9	0	1	0	60	0	1	0	60	1.1471	0.05	0	1
10	19	16	9	0	1	0	60	0	1	0	60	1.1143	0.05	0	1
11	19	17	9	0	1	0	60	0	1	0	60	1.0833	0.05	0	1
12	19	18	9	0	1	0	60	0	1	0	60	1.0541	0.05	0	1
13	19	19	9	0	1	0	60	0	1	0	60	1.0263	0.05	0	1
14	19	20	9	0	1	0	60	0	1	0	60	1.0000	0.05	0	1
15	19	21	9	0	1	0	60	0	1	0	60	0.9750	0.05	0	1
16	19	22	9	0	1	0	60	0	1	0	60	0.9512	0.05	0	1
17	19	23	9	0	1	0	60	0	1	0	60	0.9286	0.05	0	1
18	19	24	9	0	1	0	60	0	1	0	60	0.9070	0.05	0	1
19	19	25	9	0	1	0	60	0	1	0	60	0.8864	0.05	0	1
20	19	26	9	0	1	0	60	0	1	0	60	0.8667	0.05	0	1
21	19	27	9	0	1	0	60	0	1	0	60	0.8478	0.05	0	1
22	19	28	9	0	1	0	60	0	1	0	60	0.8298	0.05	0	1
23	19	29	9	0	1	0	60	0	1	0	60	0.8125	0.05	0	1

LISE++



COSY

E-BEND FOCUS

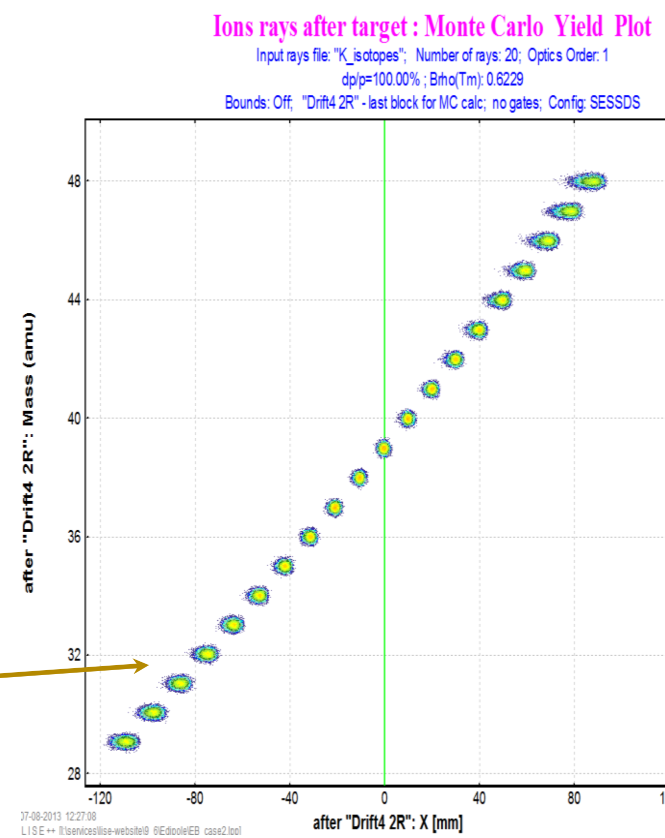
.P(

-0.9999986
0.5661256E-06
0.000000
0.000000
0.000000
$(x,dE)_1$ → 0.4000000
$(x,dM)_1$ → 0.1101071E-06
$(x,dQ)_1$ → -0.4000002

E+B BEND FOCUS

1.000045
0.6126912E-05
0.000000
0.000000
0.000000
$(x,dE)_2$ → **-0.1248663E-04**
$(x,dM)_2$ → 0.3999989
$(x,dQ)_2$ → -0.3999865

$(x,dM)_2 = (x,dE)_1$
$(x,dE)_2 = 0$



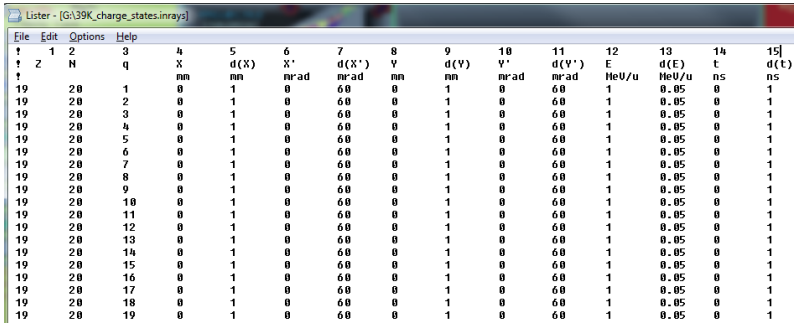
2.4 E & B bends example : q-dispersion

LISE++ file:

http://lise.nscl.msu.edu/9_6/Edipole/EB_case2.lpp

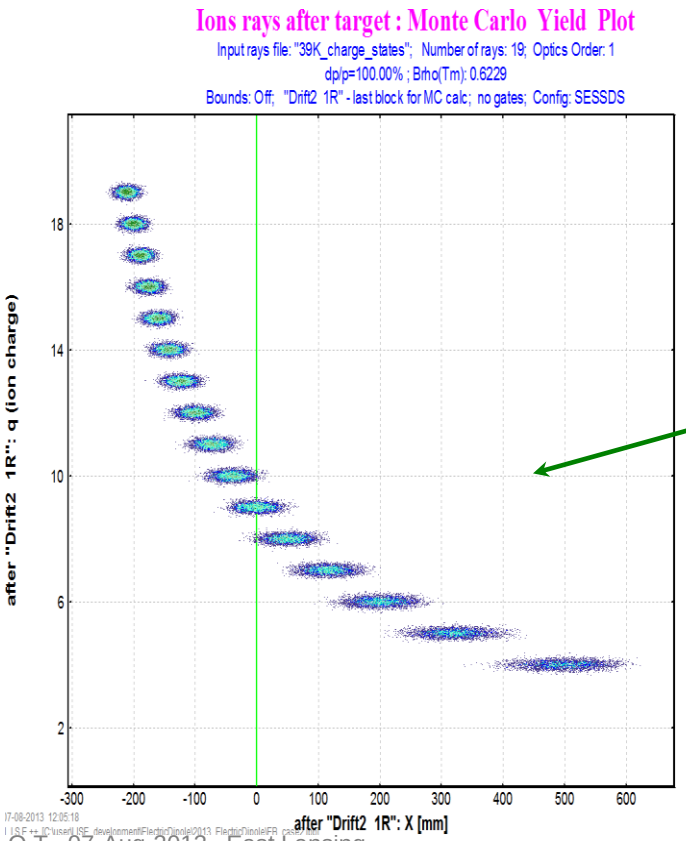
Input rays file:

http://lise.nscl.msu.edu/9_6/Edipole/39K_charge_states.inrays



# 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
# Z	N	q	X	d(X)	X'	d(X')	Y	d(Y)	Y'	d(Y')	E	d(E)	t	d(t)
#			mm	mm	mrad	mrad	mm	mm	mrad	mrad	MeV/u	MeV/u	ns	ns
19	20	1	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	2	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	3	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	4	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	5	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	6	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	7	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	8	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	9	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	10	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	11	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	12	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	13	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	14	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	15	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	16	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	17	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	18	0	1	0	60	0	1	0	60	1	0.05	0	1
19	20	19	0	1	0	60	0	1	0	60	1	0.05	0	1

LISE++ MC



COSY

E-BEND FOCUS

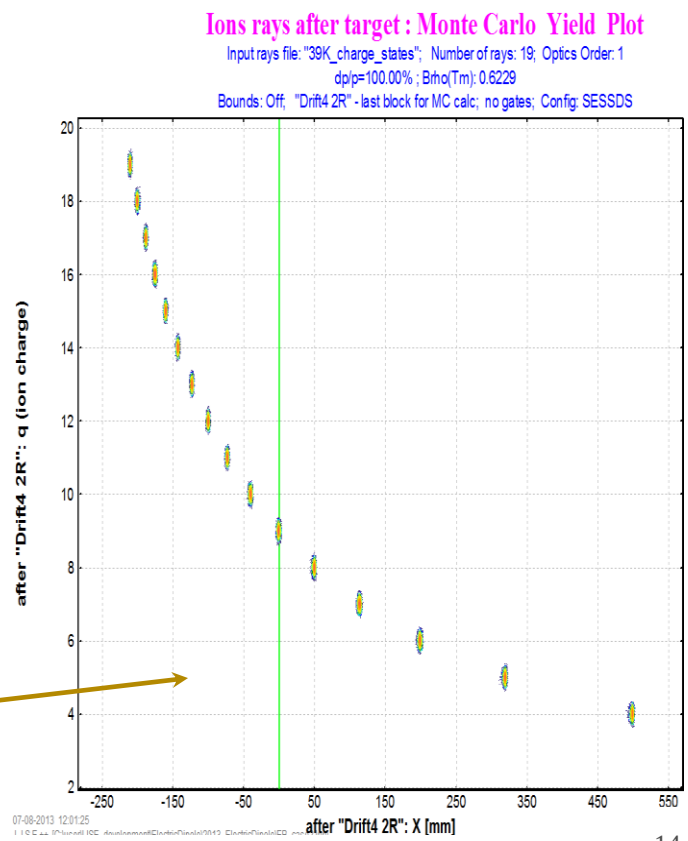
	-0.9999986
	0.5661256E-06
	0.000000
	0.000000
	0.000000
$(x,dE)_1 \rightarrow$	0.4000000
$(x,dM)_1 \rightarrow$	0.1101071E-06
$(x,dQ)_1 \rightarrow$	-0.4000002

E+B BEND FOCUS

	1.000045
	0.6126912E-05
	0.000000
	0.000000
	0.000000
$(x,dE)_2 \rightarrow$	**-0.1248663E-04**
$(x,dM)_2 \rightarrow$	0.3999989
$(x,dQ)_2 \rightarrow$	-0.3999865

$(x,dM)_2 = (x,dE)_1$

$(x,dE)_2 = 0$

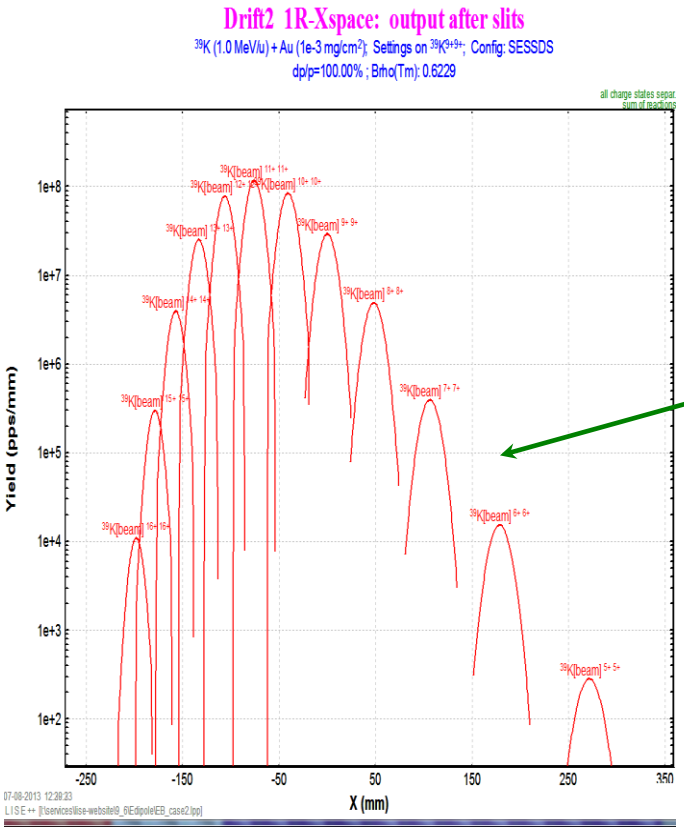


2.4 E & B bends example : q-dispersion

LISE++ file:

http://lise.nscl.msu.edu/9_6/Edipole/EB_case2.lpp

LISE++ "Distribution" method



COSY

E-BEND FOCUS

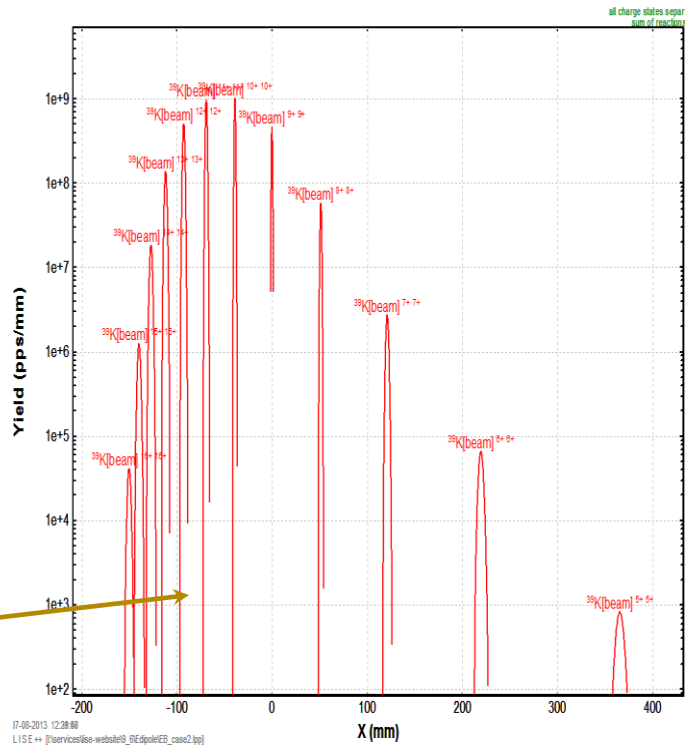
```
                -0.9999986
                 0.5661256E-06
                 0.000000
                 0.000000
                 0.000000
(x,dE)1 →        0.4000000
(x,dM) 1 →       0.1101071E-06
(x,dQ) 1 →      -0.4000002
```

E+B BEND FOCUS

```
                 1.000045
                 0.6126912E-05
                 0.000000
                 0.000000
                 0.000000
(x,dE)2 →       -0.1248663E-04
(x,dM) 2 →       0.3999989
(x,dQ) 2 →      -0.3999865
```

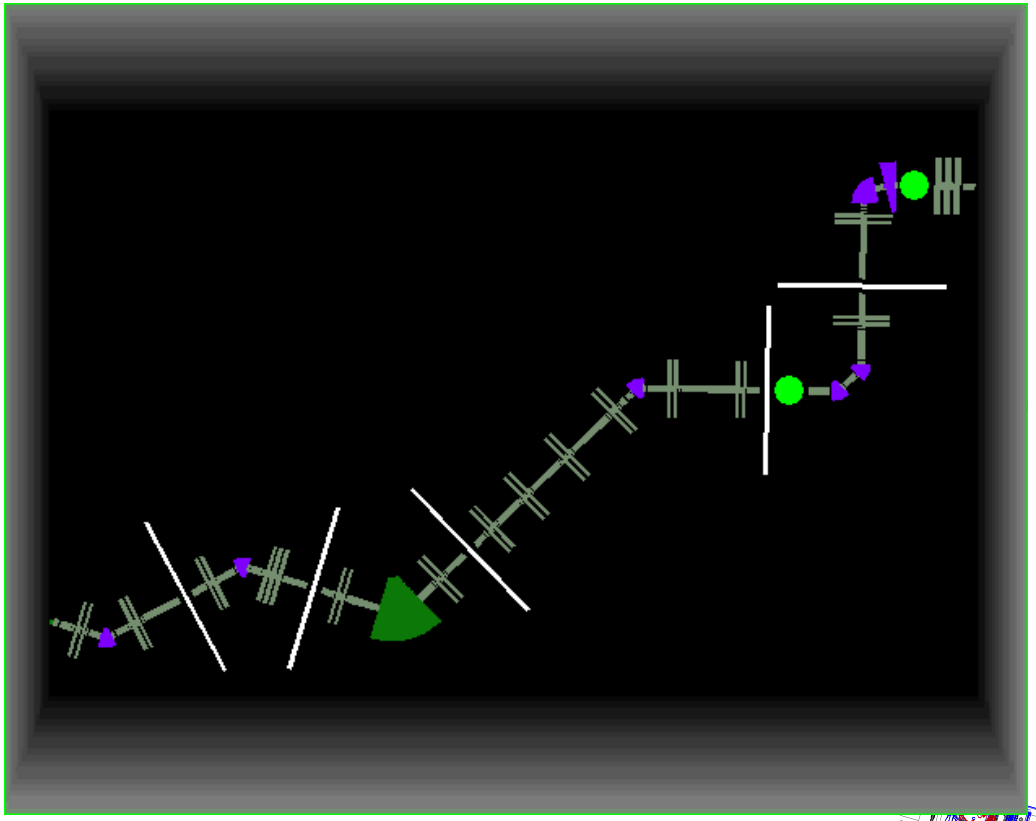
(x,dM) 2=(x,dE) 1

(x,dE) 2=0

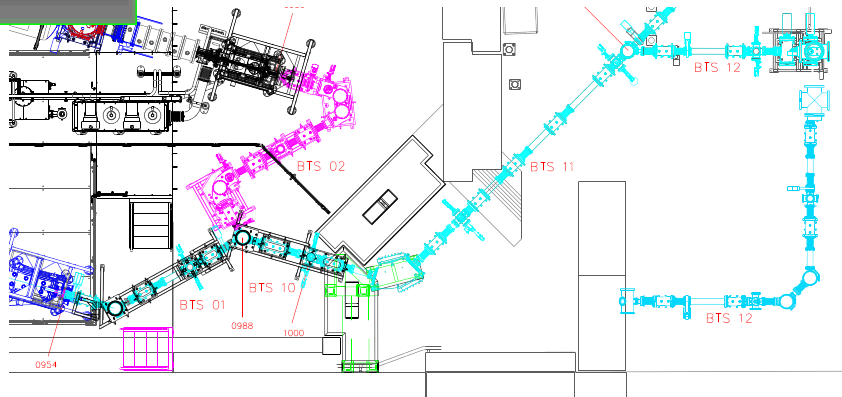


2.5 D-line : extended configuration

LISE^{++} file: http://lise.nscl.msu.edu/9_6/Edipole/D-line_BTS01-12%20with%20rotation.lpp



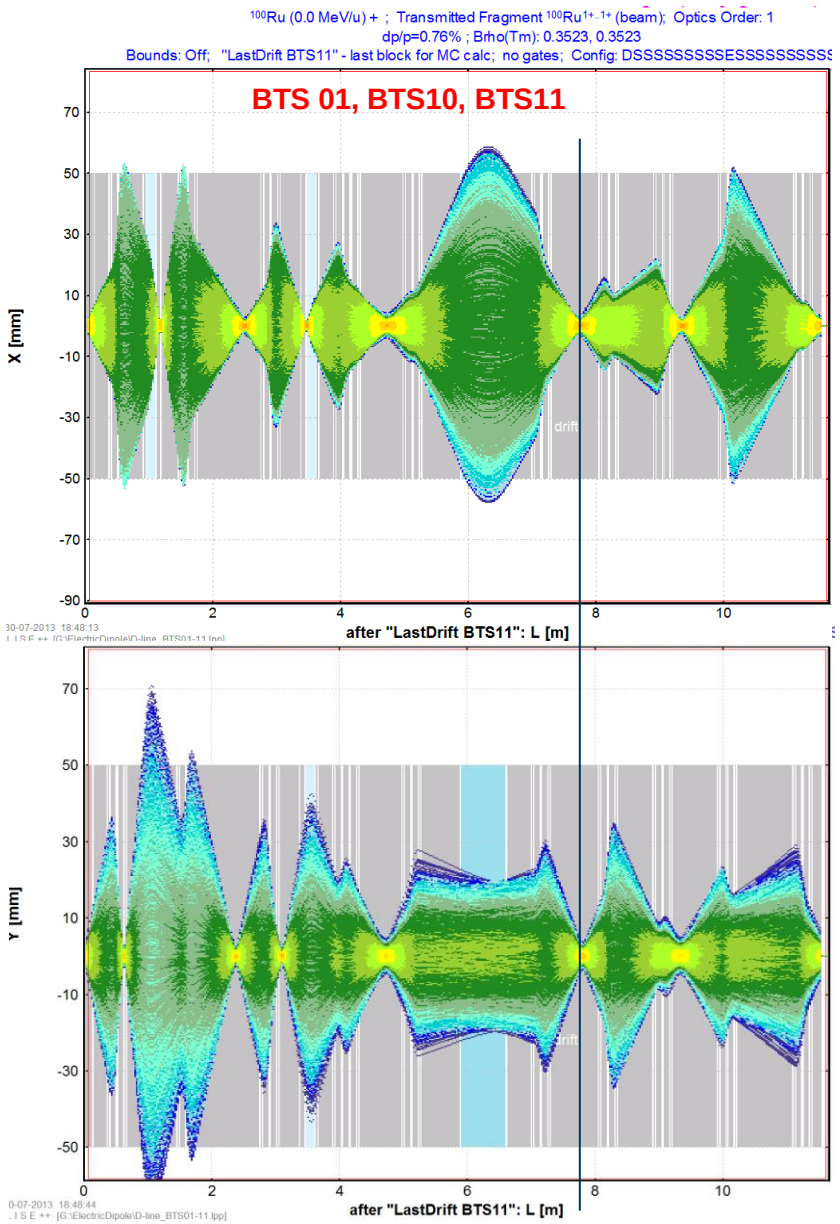
Almost 137 blocks, where
M-dipole : 1
E-dipole : 7
E-quad : 32



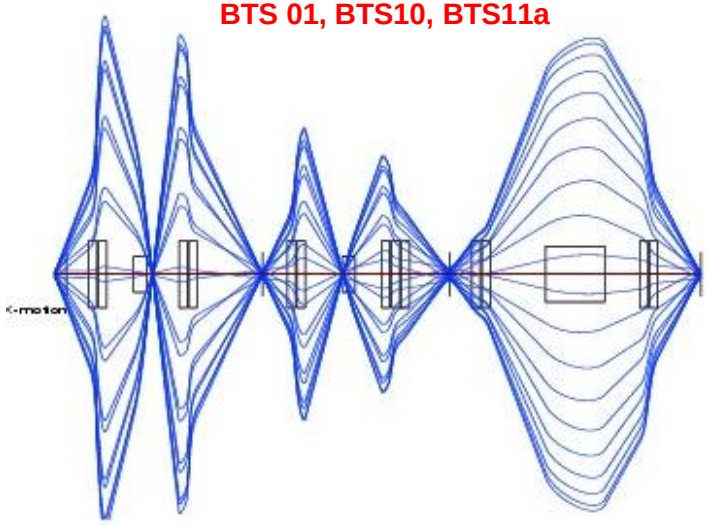
2.5 D-line : extended configuration BTS01-BTS12

LISE++ file: http://lise.nscl.msu.edu/9_6/Edipole/D-line_BTS01-12%20with%20rotation.lpp

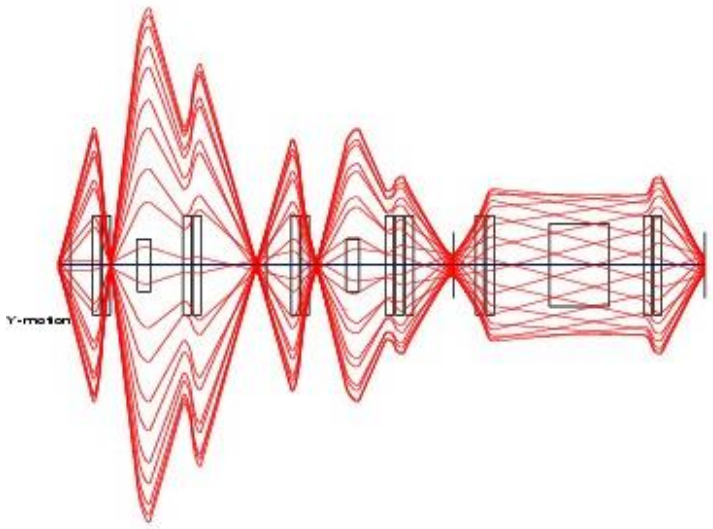
From "Report on recalculation of Low-E beam lines" by M.Portillo



X



Y



2.5 D-line : extended configuration BTS01-BTS12

LISE++ file: http://lise.nscl.msu.edu/9_6/Edipole/D-line_BTS01-12%20with%20rotation.lpp

From "Report on recalculation of Low-E beam lines" by M.Portillo

From BTS 01 up to BTS11 (11.557 m)

LISE++

Dimension: mm / cm — Matrices: Block (local) / Global

Global matrix

-1.4935	0.00031	0	0	0	-2.91438	[cm]
-99.5517E	-0.64903	0	0	0	-63.6277	[mrad]
0	0	-2.58371	0.00201	0	0	[cm]
0	0	51.03785	-0.42698	0	0	[mrad]
19.5267	0.19121	0	0	1	12.23006	[cm]
0	0	0	0	0	1	[%]
/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]	

Det = 1.00079

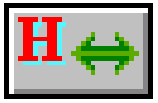
COSY

Lister - [c:\user\cosy\LISE_COSY_App\BTS11.TXT]

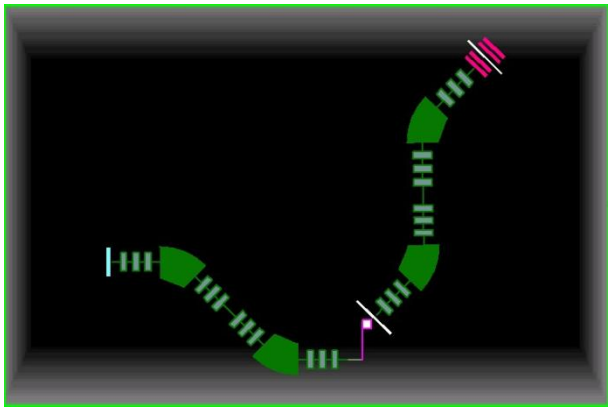
File Edit Options Help

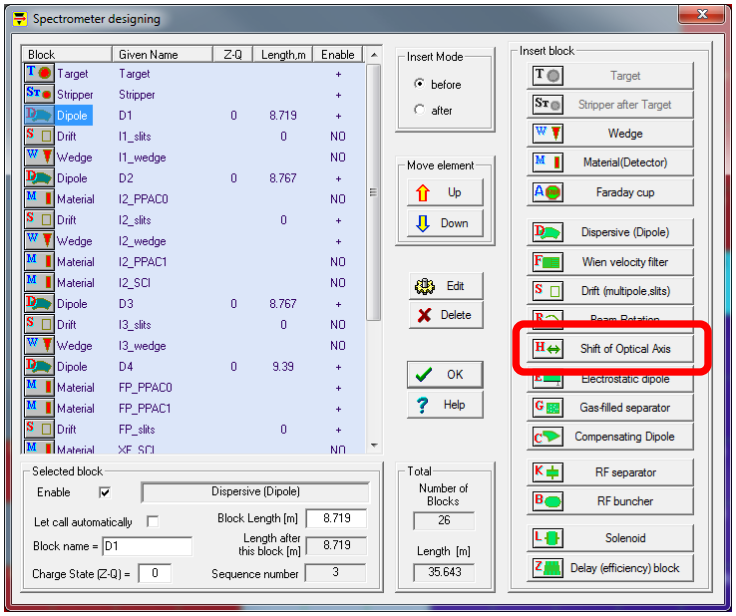
```
 6 1
 -.15079E+01   .16189E-03   .00000E+00   .00000E+00   .00000E+00  -.29255E+01
 -.99674E+02  -.65248E+00   .00000E+00   .00000E+00   .00000E+00  -.63654E+02
  .00000E+00   .00000E+00  -.27137E+01  -.10732E-03   .00000E+00   .00000E+00
  .00000E+00   .00000E+00   .56317E+02  -.36628E+00   .00000E+00   .00000E+00
  .19561E+02   .19191E+00   .00000E+00   .00000E+00   .10000E+01   .12250E+02
  .00000E+00   .00000E+00   .00000E+00   .00000E+00   .00000E+00   .10000E+01
------------------ MAP IN TRANSPORT UNITS, COSY FORMAT, PM
   .2798727E-07  .6089625E-06  .0000000      .0000000     -.1171928E-06 000000
  -1.507879     -99.67437      .0000000      .0000000      19.56116     100000
   .1618946E-03 -.6524815      .0000000      .0000000      .1919118     010000
   .0000000      .0000000     -2.713679      56.31713      .0000000     001000
   .0000000      .0000000     -.1073191E-03 -.3662762      .0000000     000100
   .0000000      .0000000      .0000000      .0000000     1.000000     000010
  -2.925466     -63.65392      .0000000      .0000000     12.24998     000001
 ---------------------------------------------------------------------------
```

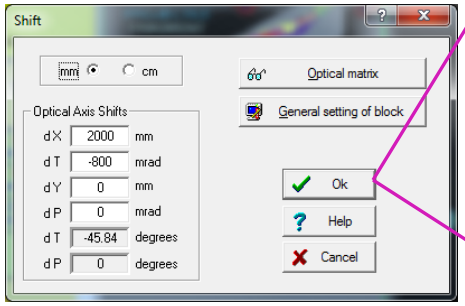
3. New optical block : “Shift”

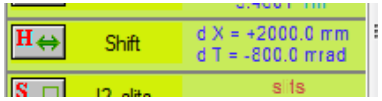


Allows to simulate misalignment, projectile scattering and so on.





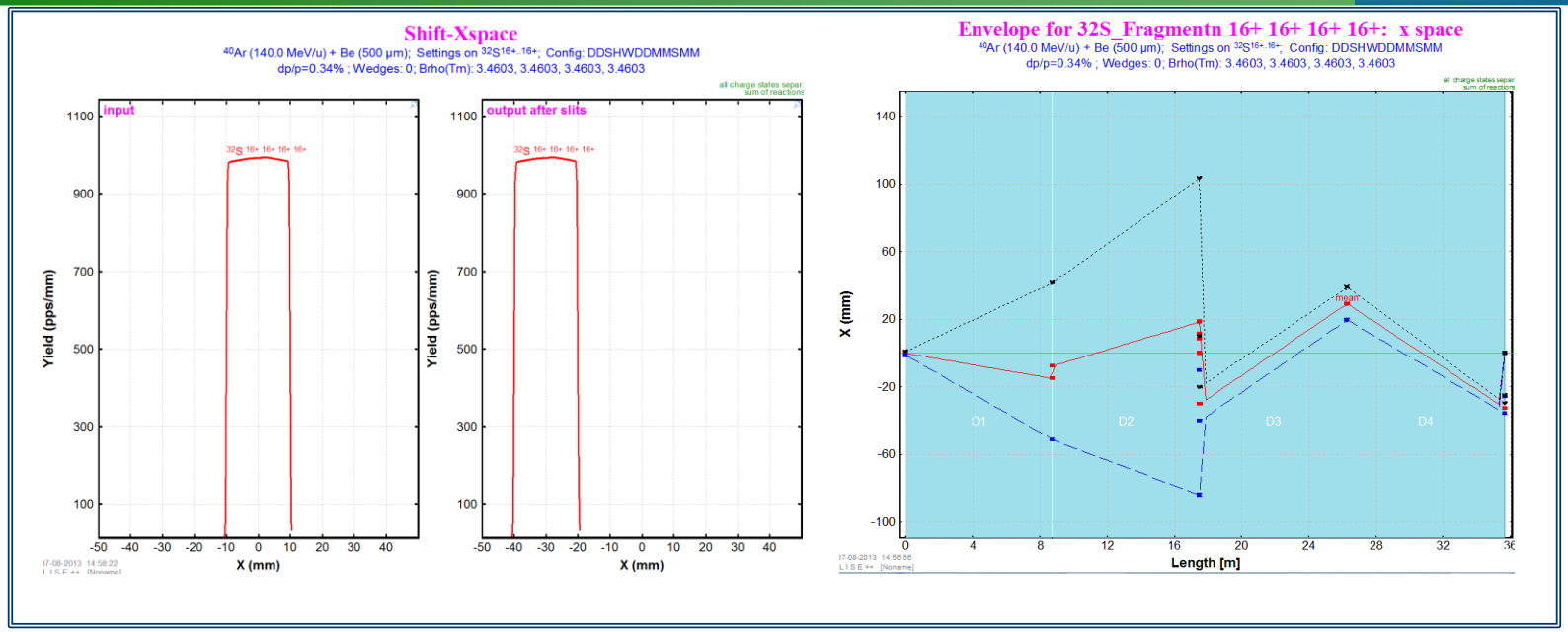


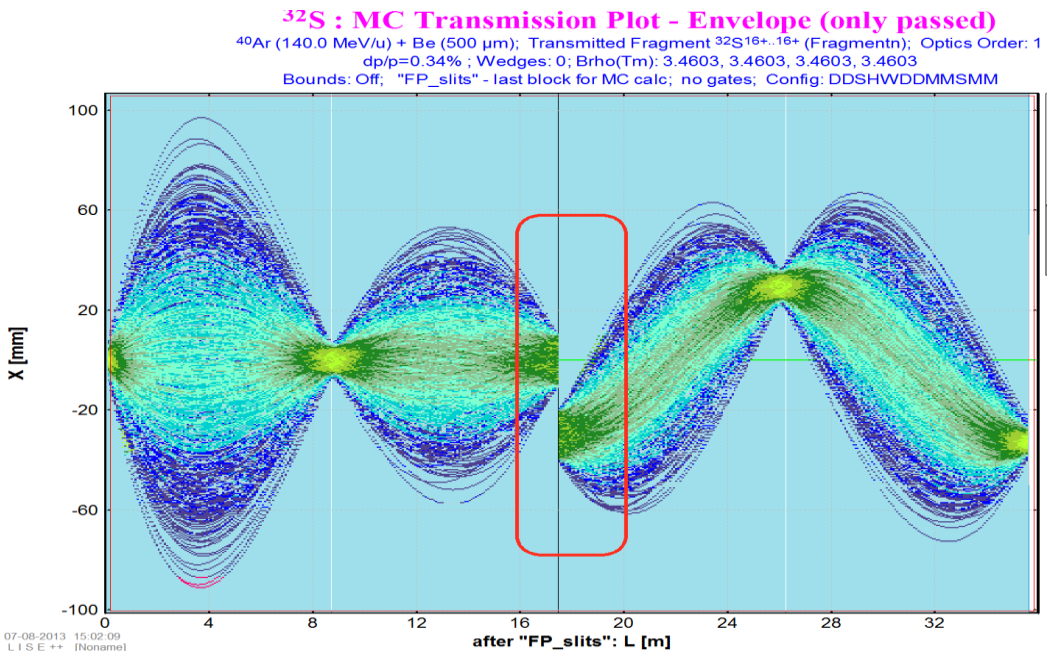


- **Property : optical block**
- **Always Identity matrix**
- **Length block = 0**

3. New optical block : "Shift"

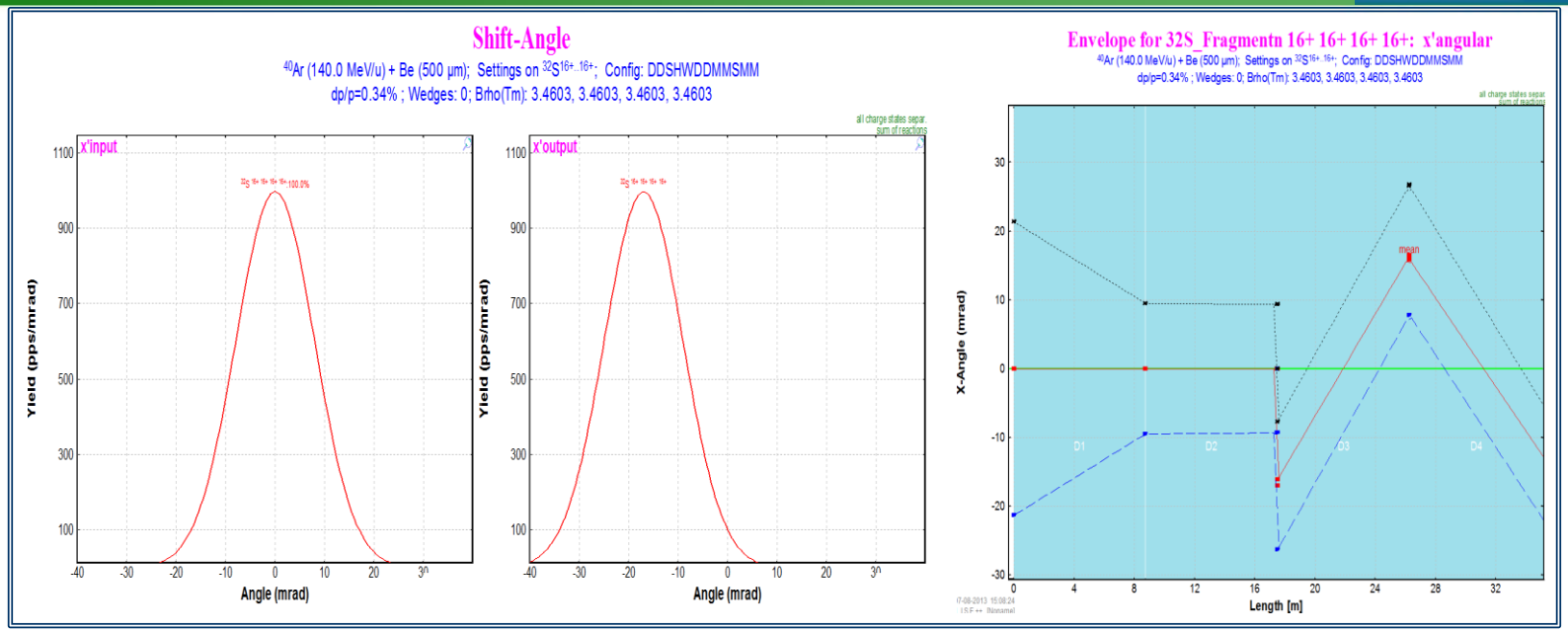
Example
X-shift of axis:
+30 mm

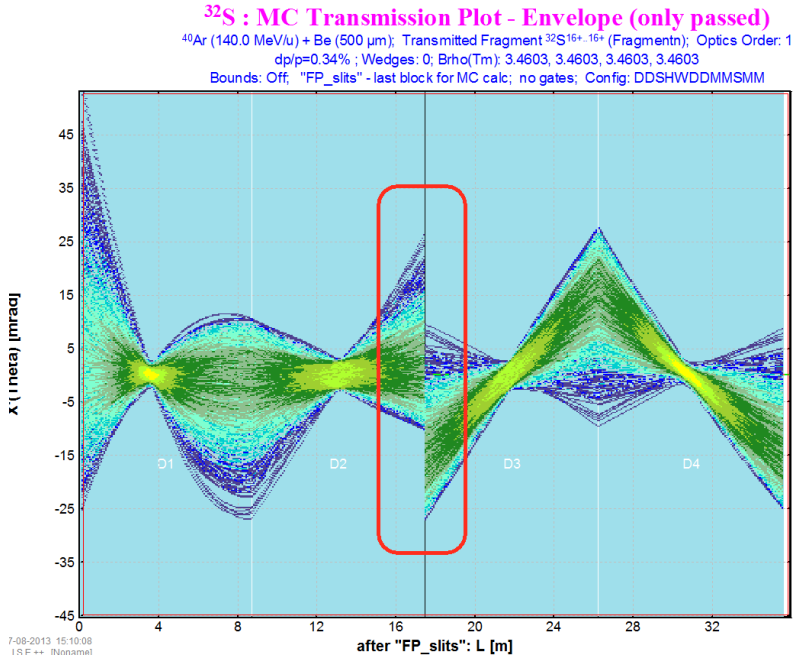




3. New optical block : "Shift"

Example
X'-shift of axis:
+17 mrad

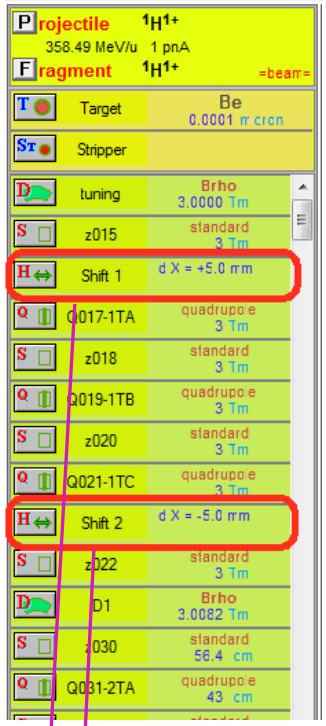


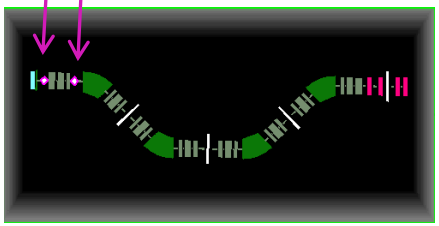


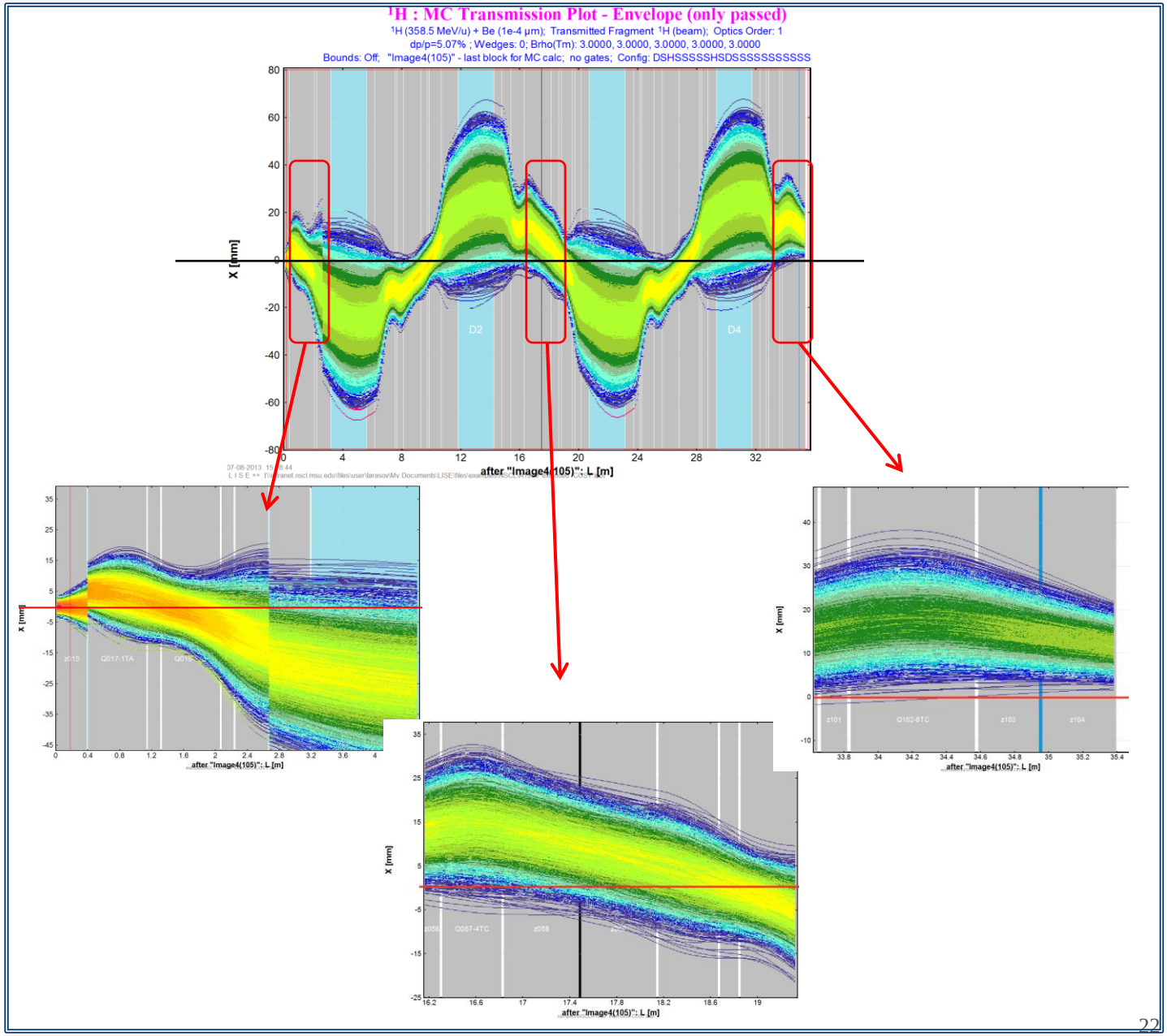
3.1 Optical block "Shift" : triplet misalignment

Example:
1st triplet 5 mm
All dipoles set to 3.0 Tm

LISE++ file: http://lise.nscl.msu.edu/9_6/Edipole/misalignemnt_A1900_extended_COSY.lpp





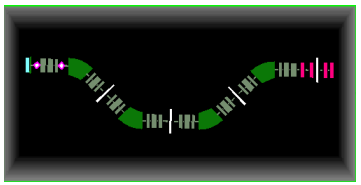


3.1 Optical block "Shift" : triplet misalignment

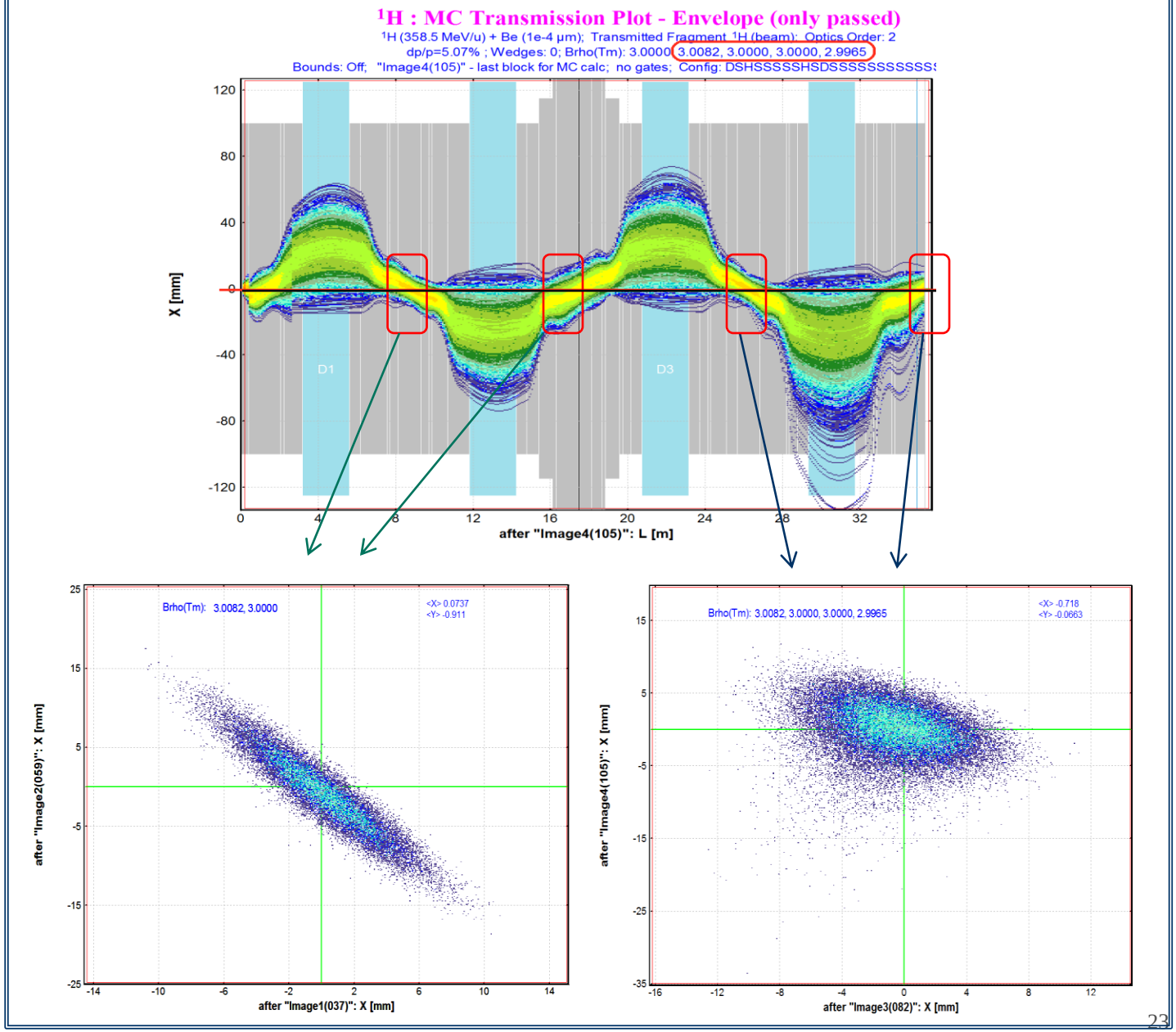
LISE++ file: http://lise.nscl.msu.edu/9_6/Edipole/misalignemnt_A1900_extended_COSY.lpp

Example:
1st triplet 5 mm

Playing with Dipoles to be for Images at the central axis



	Brho, Tm		
	Initial	Set	Set/Init
Beam	3	3	-
Dipole 1	3	3.0082	0.27%
Dipole 2	3	3	-
Dipole 3	3	3	-
Dipole 4	3	2.9965	-0.12%



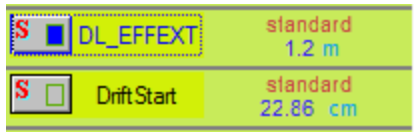
Others

9.6.116 08/01/13

- **Update in block selection at the Spectrometer Scheme**
- **Subtitles Correction in W_Graph**

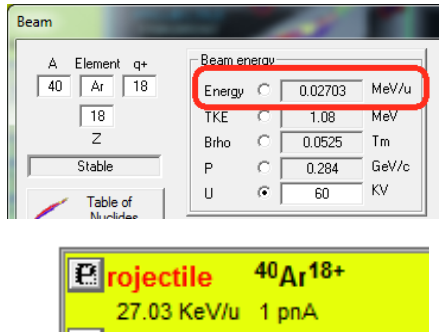
9.6.112 07/31/13

- **Increase of precision in the Setup dialog for length, fields, and in LPP-files**



9.6.108 07/29/13

***ShowSetup -- Energy beam format modification**



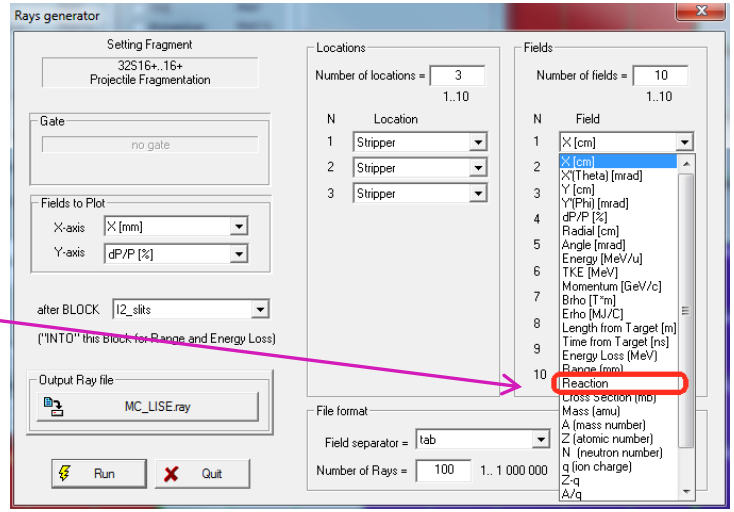
9.6.102 07/25/13

- **Brho-alayzer modification for dispersion**
- **Equilibrium thickness from SRIM**
- **Modification Dim & Unit in distributions**
- **Global revision Beta,Gamma,Brho, Erho functions**

9.6.95 07/22/13

- **Window Message in the case of error in MC_trans_init_array (for debug)**
- **Modification WGauge for MC and creation TStatusBar for MC initialization**
- **Scroller revision in TWindowList**

- **The Reaction parameter in MC output file**



- *** New address for dynamical menu. New indexation!!!**

Due to that :

- *** new threshold: 30 000 ions for Monte Carlo transmission calculations**
- *** new threshold: 30 000 ions for analytical transmission calculations**
- **• new threshold: 300 blocks available in LISE++**

Others

• Corrections for the "Analytical Calculation" button @ MC transmission dialog

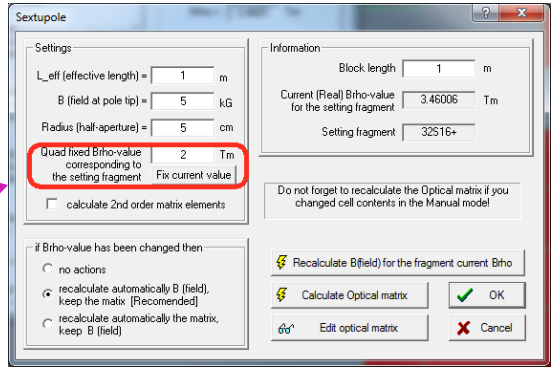
• Correction for the "Beam-Fragment charge states" plot in the case of Stripper

•Remember the last input mode (Brho or B) in Optical block dialogs

• New button Fix Brho (Erho) value in the quadrupole dialogs

• Glyph button correction in the case of change of Drift type

* The "Ideal magnet" dialog revision

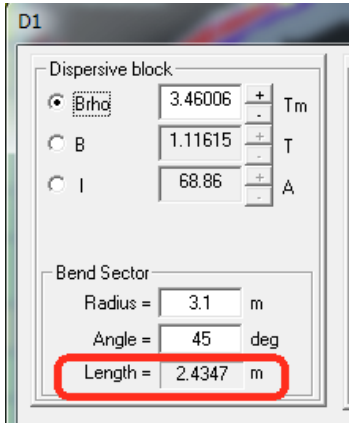


9.6.75 07/11/13

* Correction in Multiple Reactions use (when AF and PF together, and AF is the first)
* Correction in Multiple Reactions use settings at loading the code with lpp.argument

• Correction for the message of IsoMode in the Rays Output generator dialog

• Bend length cell in all Dipole dialogs (D6, Dip, ED, GFS)



9.6.68 07/08/13

•Correction in MC transmission to avoid a crash (sigma-per & NCALC_MC)

* Gauges in MC transmission & checking or memory for case of several isotopes

•Calculation of backward transmission (realistic)

* Modifications in Matrix Kinematics (Fission, Two-body reactions)