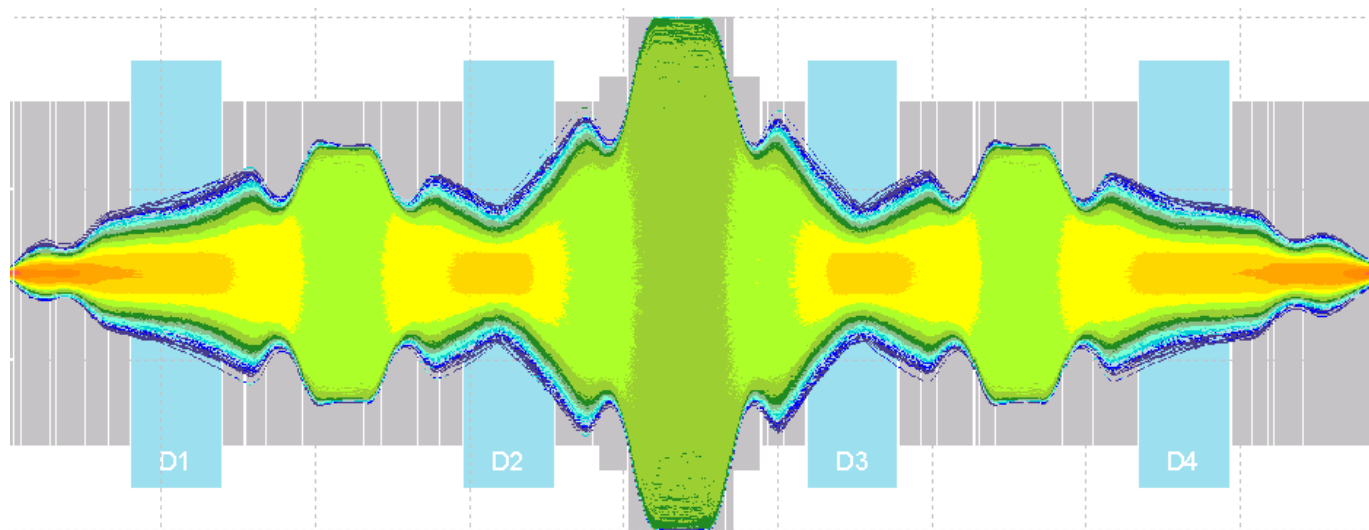


version 9.0.39

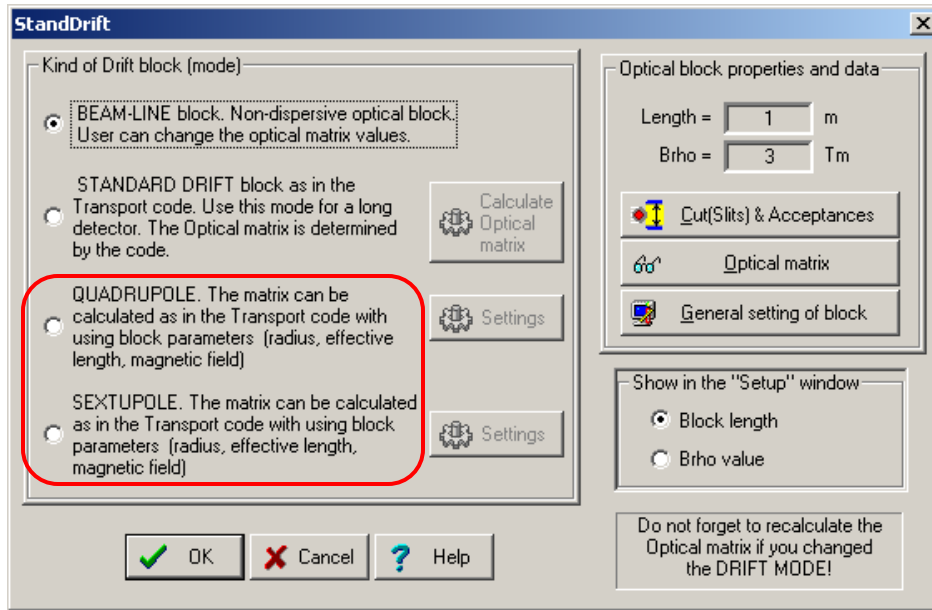


Contents:

- *Drift block: Quadrupole and Sextupole options*
- *Construction of the A1900 expanded configuration*
- *Momentum acceptance*
- *Angular acceptance*
- *Comparison of different A1900 configurations*
- *Expanded configuration vs. Distribution method*

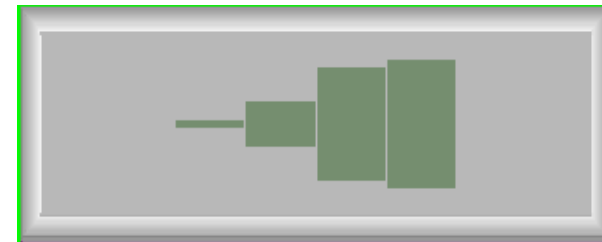
The code operates under MS Windows environment and provides a highly user-friendly interface.
It can be freely downloaded from the following internet addresses:

<http://www.nsci.msu.edu/lise>



Instead to import a transport matrix, now it is possible to calculate matrices 1st and 2nd orders. It allows to create faster “expanded” configurations (no joint blocks such as Q+Q+Q+D+Q+Q+Q).

S	<input type="checkbox"/>	StandDrift	standard 1 m
S	<input type="checkbox"/>	Beamline	beam-line 1 m
S	<input type="checkbox"/>	Quad	quadrupole 1 m
S	<input type="checkbox"/>	Sext	sextupole 1 m



DRIFT block:

Charge state is not attributed to this optical block.

Non-dispersive block

Beam-line : User can change the optical matrix values.

Do not enter DISPERSON coefficients!!

StandDrift

Kind of Drift block (mode)

- BEAM-LINE block. Non-dispersive optical block. User can change the optical matrix values.
- STANDARD DRIFT block as in the Transport code. Use this mode for a long detector. The Optical matrix is determined by the code. Calculate Optical matrix
- QUADRUPOLE. The matrix can be calculated as in the Transport code with using block parameters (radius, effective length, magnetic field) Settings
- SEXTUPOLE. The matrix can be calculated as in the Transport code with using block parameters (radius, effective length, magnetic field) Settings

Optical block properties and data

Length = m
Brho = Tm

Cut(Slits) & Acceptances
Optical matrix
General setting of block

Show in the "Setup" window

- Block length
- Brho value

Do not forget to recalculate the Optical matrix if you changed the DRIFT MODE!

Optical matrix - StandDrift

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

Dimension: mm cm

Matrices: Block (local)

Block matrix:

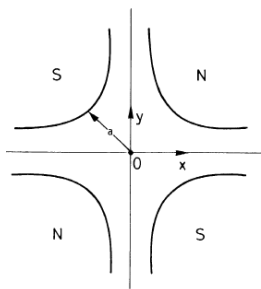
1. X	1	1	0	0	0	0
2. T	0	1	0	0	0	0
3. Y	0	0	1	1	0	0
4. F	0	0	0	1	0	0
5. L	0	0	0	0	1	0
6. D	0	0	0	0	0	1

/[mm] /[mrad] /[mm] /[mrad] /[mm] /[%]

Det = 1.00000 Import COSY map view

Drift (space) Ok Cancel

"Transport"



First-order quadrupole matrix

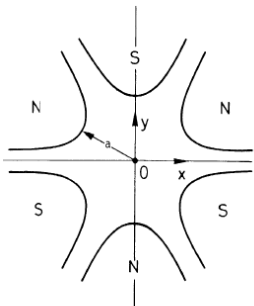
$$\begin{pmatrix}
 \cos k_q L & \frac{1}{k_q} \sin k_q L & 0 & 0 & 0 & 0 \\
 -k_q \sin k_q L & \cos k_q L & 0 & 0 & 0 & 0 \\
 0 & 0 & \cosh k_q L & \frac{1}{k_q} \sinh k_q L & 0 & 0 \\
 0 & 0 & k_q \sinh k_q L & \cosh k_q L & 0 & 0 \\
 0 & 0 & 0 & 0 & 1 & 0 \\
 0 & 0 & 0 & 0 & 0 & 1
 \end{pmatrix}$$

QUADRUPOLE

$k_q^2 = (B_0/a)(1/B\rho_0)$, where $(B\rho_0)$ = the magnetic rigidity (momentum) of the central trajectory.

Pay attention for Lengths:

- Effective quadrupole length (it is used for optical calculations)
- Block length (used for scheme, for ToF calculations, for MC envelope)



SEXTUPOLE

Sextupole from optic point view is standard drift block + 2nd order matrix

Sextupole [?] [X]

Settings

L_{eff} (effective length) = m

B (field at pole tip) = kG

Radius (half-aperture) = cm

calculate 2nd order matrix elements

Information

Block length m

Corresponding Bhro-value for the setting fragment Tm

Setting fragment

```

Block: "Sext" Matrices: "LOCAL"
Block: "Sext" Matrices: "LOCAL"
transport format [cm-mrad]

* TRANSFORM 1 *
1 [X]: +1.0000e+00 +1.0000e-01 0 0 0 0
2 [T]: 0 +1.0000e+00 0 0 0 0
3 [Y]: 0 0 +1.0000e+00 +1.0000e-01 0 0
4 [F]: 0 0 0 +1.0000e+00 +1.0000e+00 0
5 [L]: 0 0 0 0 +1.0000e+00 0
6 [D]: 0 0 0 0 0 +1.0000e+00

* TRANSFORM 2 *
1 1: -8.3333e+00
1 2: -5.5556e-01 -1.3889e-02
1 3: 0 0 +8.3333e+00
1 4: 0 0 +5.5556e-01 +1.3889e-02
1 5: 0 0 0 0 0 0
1 6: 0 0 0 0 0 0

2 1: -1.6667e+02
2 2: -1.6667e+01 -5.5556e-01
2 3: 0 0 +1.6667e+02
2 4: 0 0 +1.6667e+01 +5.5556e-01
2 5: 0 0 0 0 0 0
2 6: 0 0 0 0 0 0

3 1: 0
3 2: 0
3 3: +1.6667e+01 +5.5556e-01 0
3 4: +5.5556e-01 +2.7778e-02 0 0
3 5: 0 0 0 0 0 0
3 6: 0 0 0 0 0 0

4 1: 0
4 2: 0
4 3: +3.3333e+02 +1.6667e+01 0
4 4: +1.6667e+01 +1.1111e+00 0 0
4 5: 0 0 0 0 0 0
4 6: 0 0 0 0 0 0

5 1: 0
5 2: 0 0
5 3: 0 0 0
5 4: 0 0 0 0
5 5: 0 0 0 0 0
5 6: 0 0 0 0 0 0

6 1: 0
6 2: 0 0
6 3: 0 0 0
6 4: 0 0 0 0
6 5: 0 0 0 0 0
6 6: 0 0 0 0 0 0
    
```

Optical matrix - Sext [?] [X]

$G_i = L_i^{-1} G_{i-1}$

Dimension: mm cm

Matrices: Block (local) Global

Second Order LOCAL matrix: Non Exit only for Monte Carlo transmission

Block matrix							Global matrix							Beam (sig)	
	1	2	3	4	5	6									
1. X	1	0	0	0	0	0	-2.01892	-0.17411	0	0	0	0	0.649		
2. T	0	0.1	0	0	0	0	-17.6673	-2.01892	0	0	0	0	7.17		
3. Y	0	0	1	0	0	0	0	0	8.70374	1.35498	0	0	4.656		
4. F	0	0	0	1	0	0	0	0	55.1949	8.70374	0	0	29.892		
5. L	0	0	0	0	1	0	0	0	0	0	1	0	0		
6. D	0	0	0	0	0	1	0	0	0	0	0	1	0.15		
	/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]	/[cm]	/[mrad]	/[cm]	/[mrad]	/[cm]	/[%]		2nd order view	

Det = 1.00000

Det = 1.00024

My Documents\LISE\config\NSCL \A1900_expanded.lcn
 My Documents\LISE\files \examples\A1900_expanded.lpp

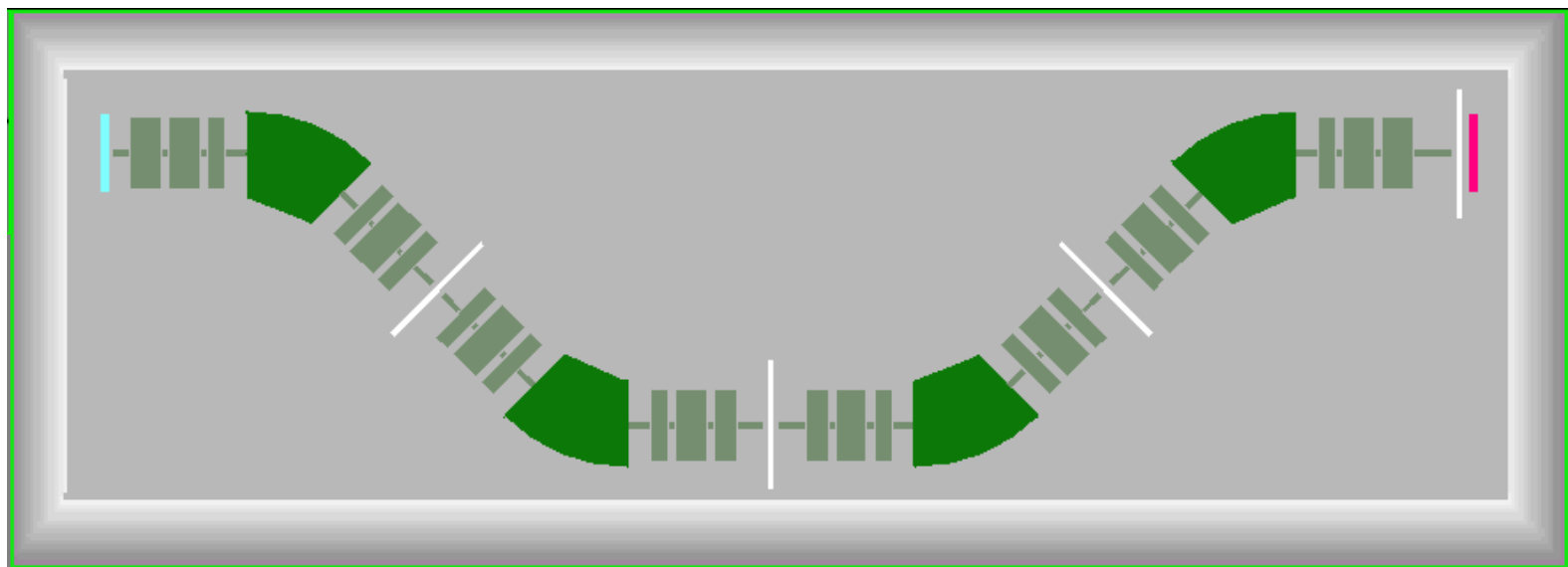
BlockStructure = TSSSSSSSDSSSSSSSSSSSSSSSSSSSDSSSSSSSSSSSSSSSSSDSSSSSSSSSSSSSSSSSDSSSSSSSSSSSSSSSSSDSSSSSSSSSM

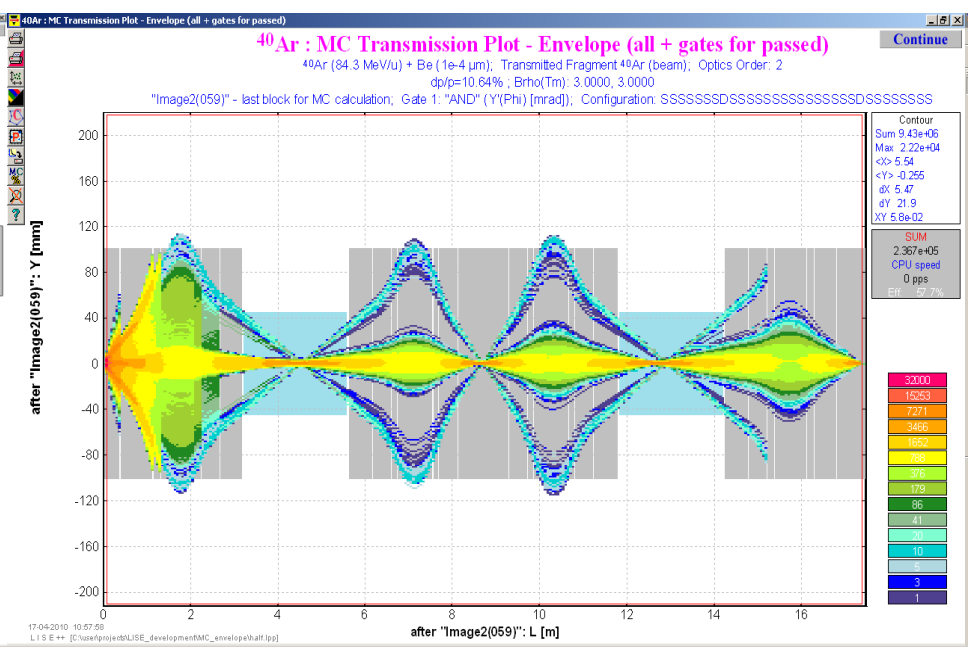
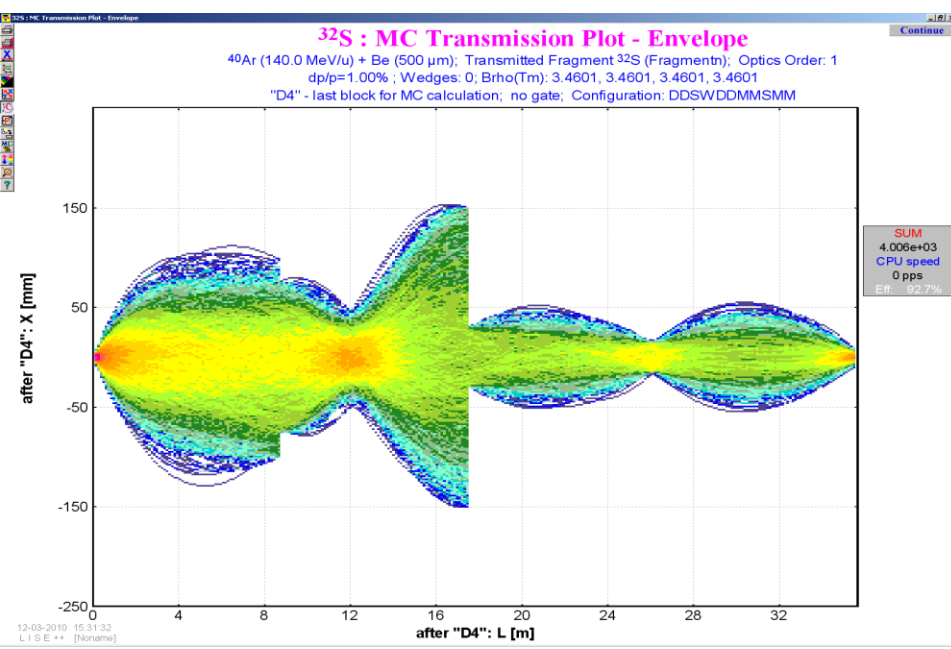
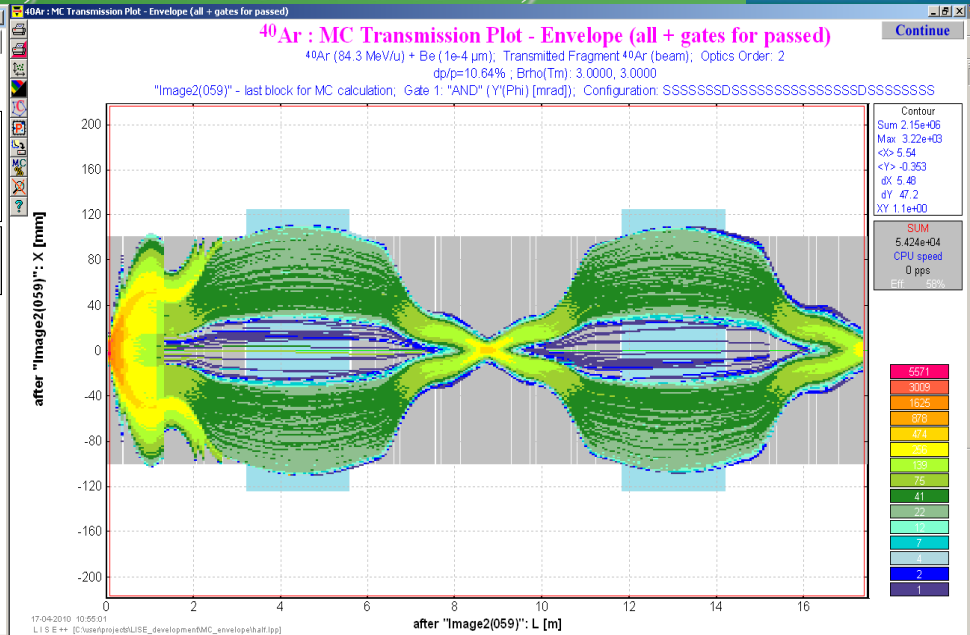
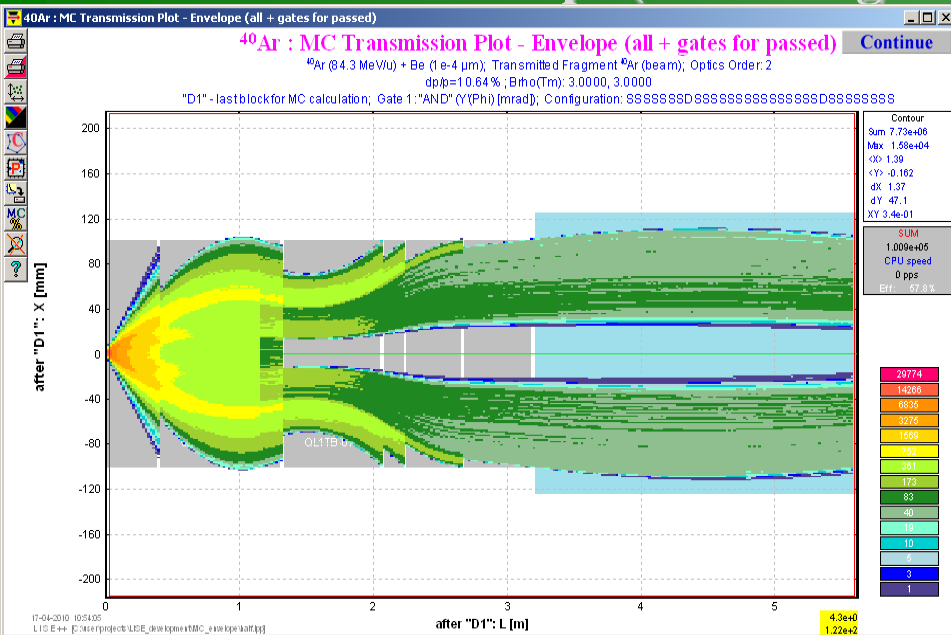
66 blocks!!

No angular acceptance values

Dipole Block (Rot+Dip+Rot) matrices are taken from Transport calculations (1st order)

All drift block matrices have been calculated in LISE++

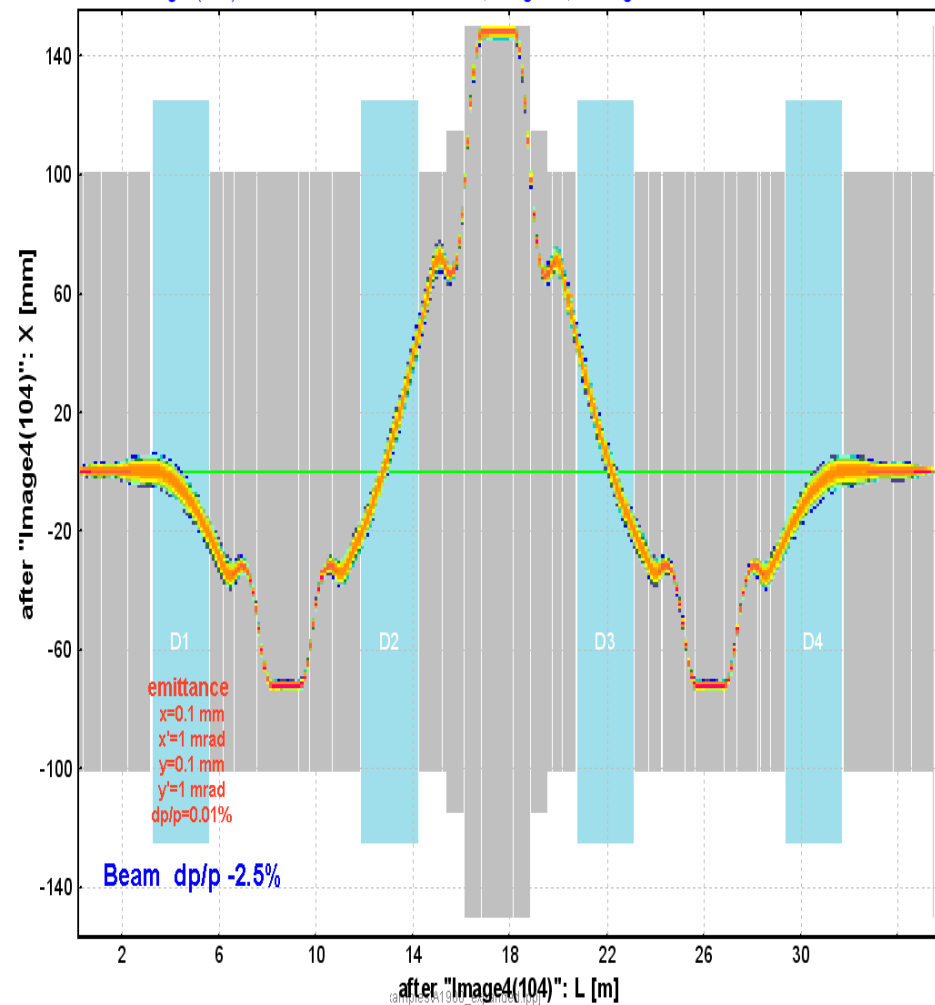




⁴⁰Ar : MC Transmission Plot - Envelope (only passed)

⁴⁰Ar (80.3 MeV/u) + Be (1e-4 μm); Transmitted Fragment ⁴⁰Ar (beam); Optics Order: 1
 dp/p=5.07%; Brho(Tm): 3.0000, 3.0000, 3.0000, 3.0000

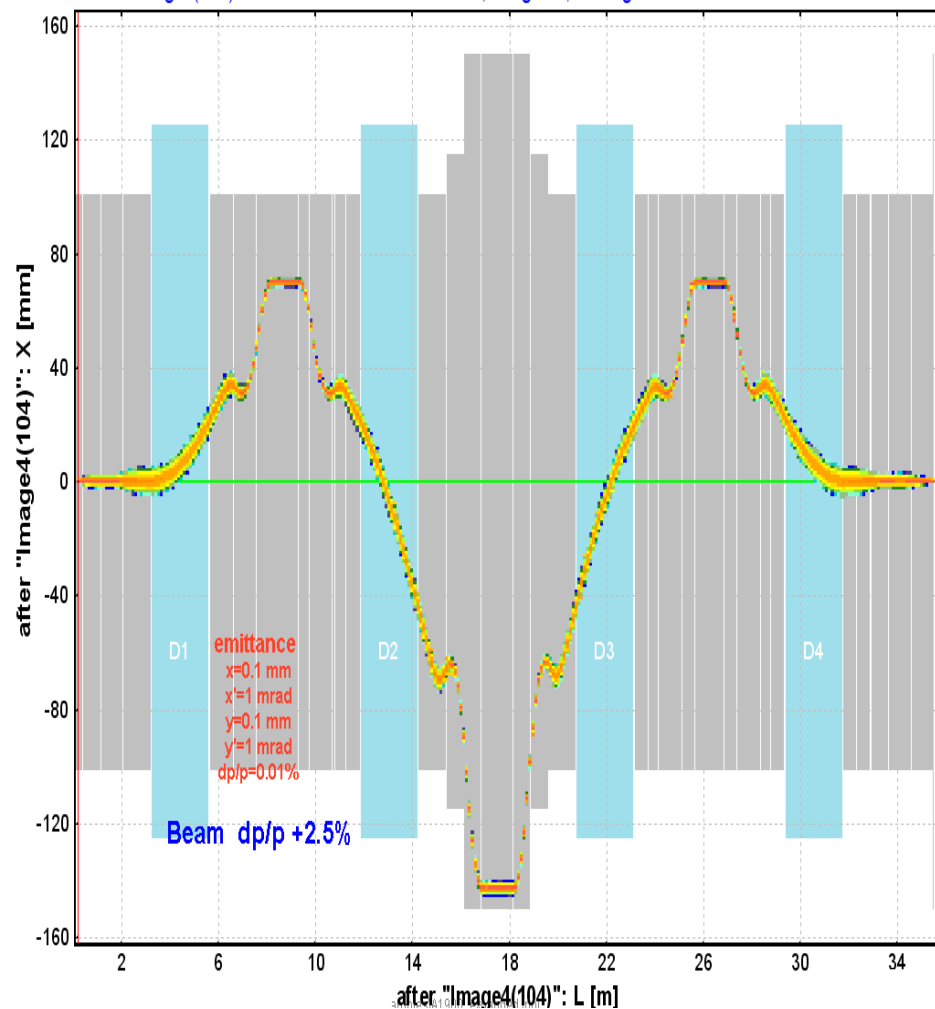
"Image4(104)" - last block for MC calculation; no gates; Configuration: SSSSSSDSSSSSSSSSSSS

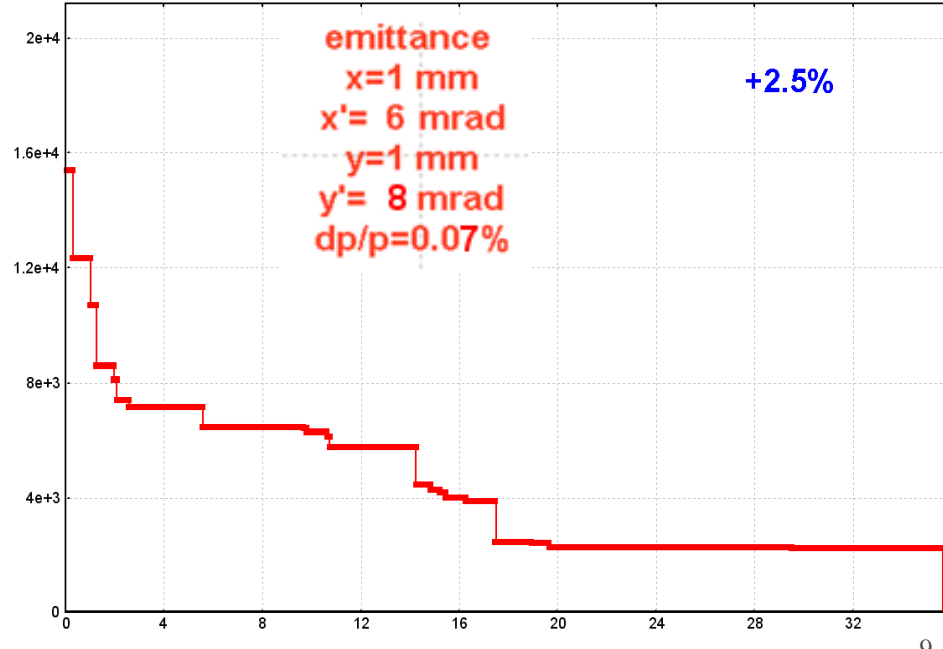
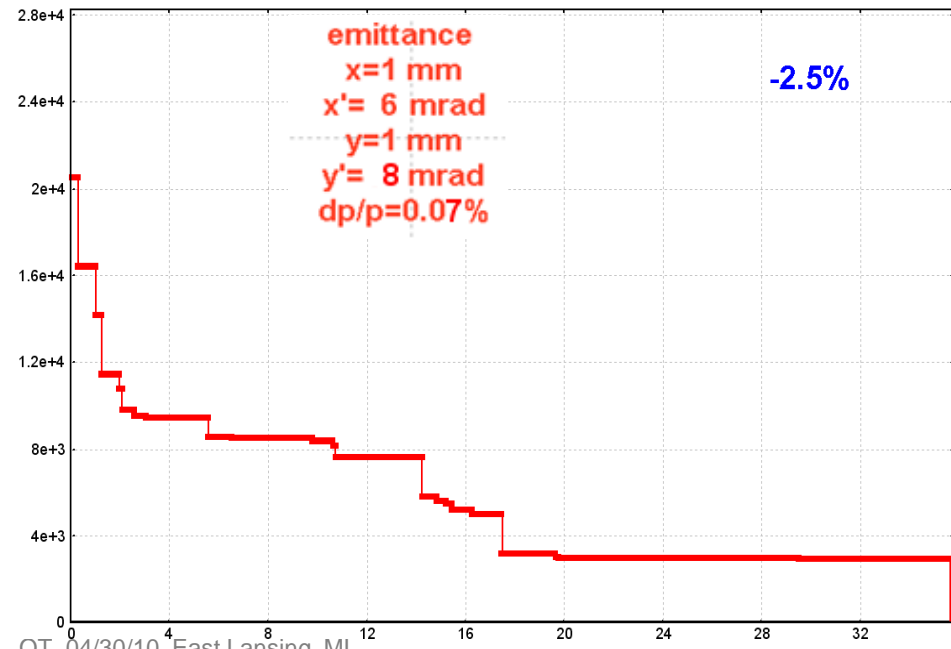
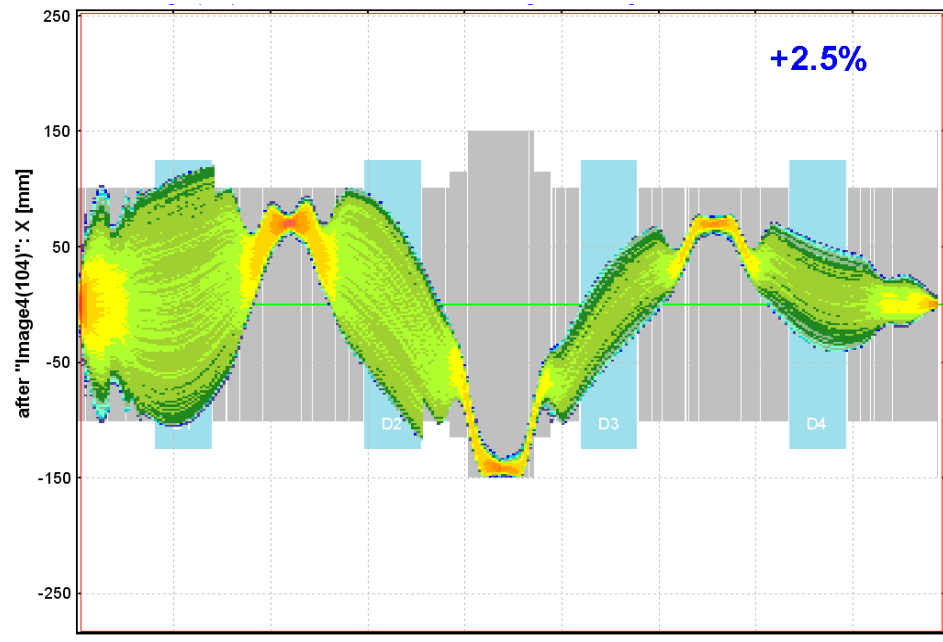
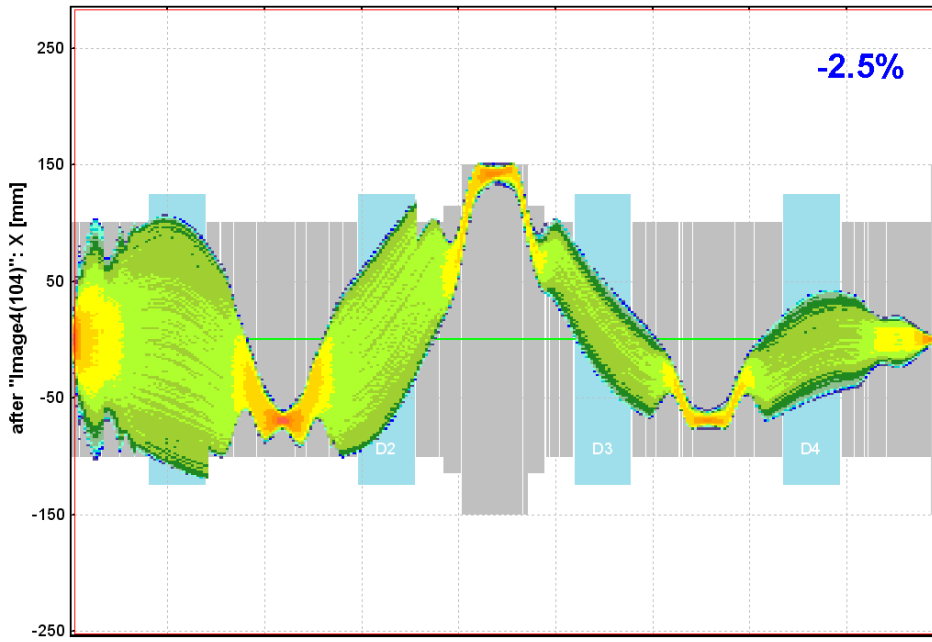


⁴⁰Ar : MC Transmission Plot - Envelope (only passed)

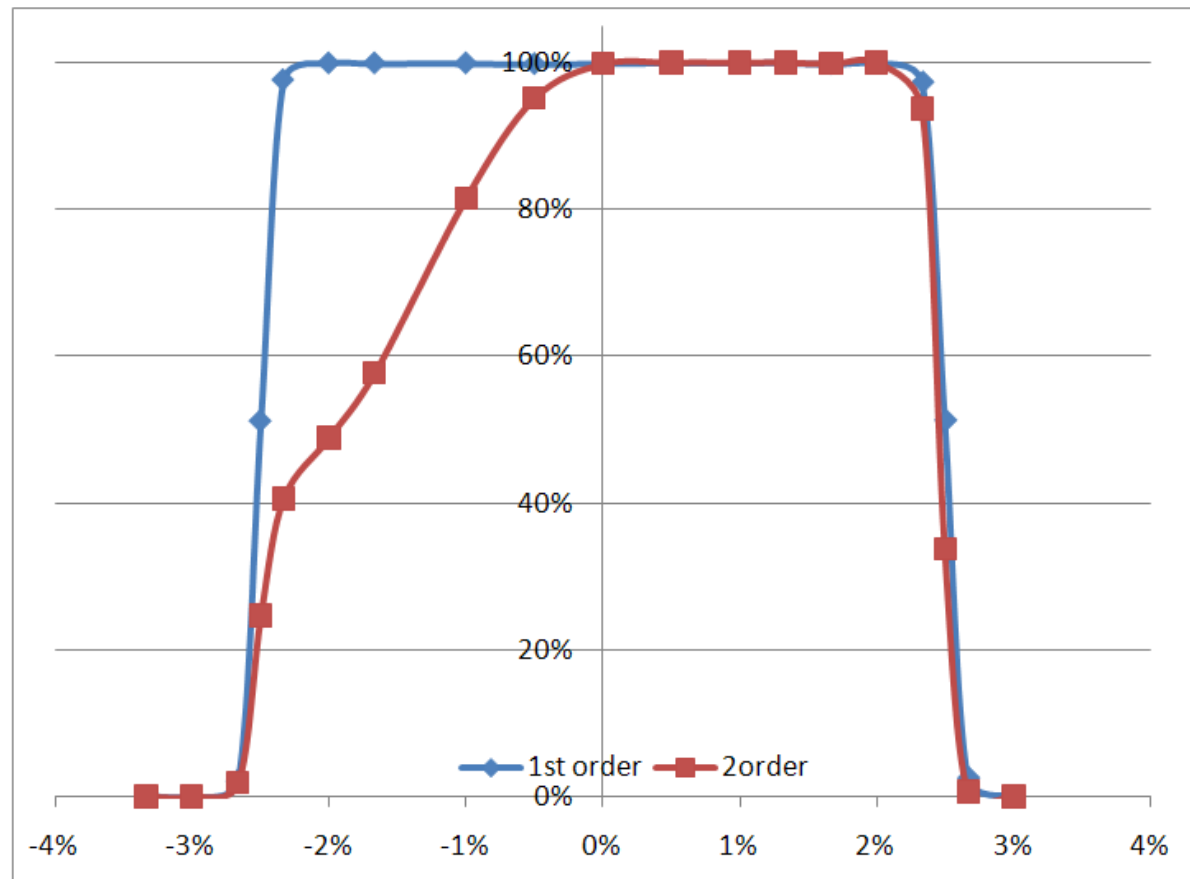
⁴⁰Ar (80.3 MeV/u) + Be (1e-4 μm); Transmitted Fragment ⁴⁰Ar (beam); Optics Order: 1
 dp/p=5.07%; Brho(Tm): 3.0000, 3.0000, 3.0000, 3.0000

"Image4(104)" - last block for MC calculation; no gates; Configuration: SSSSSSDSSSSSSSSSSSS

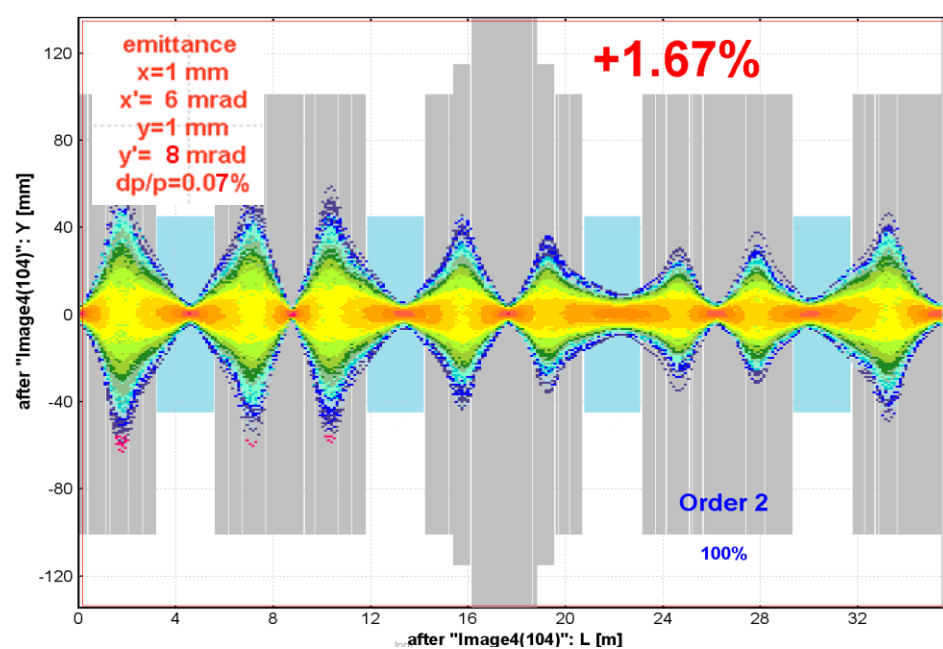
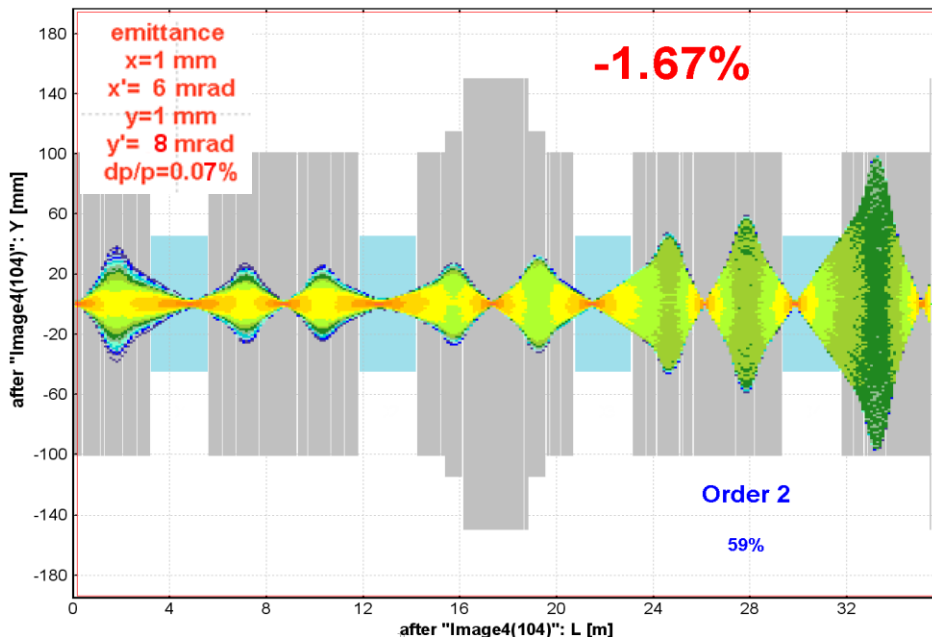
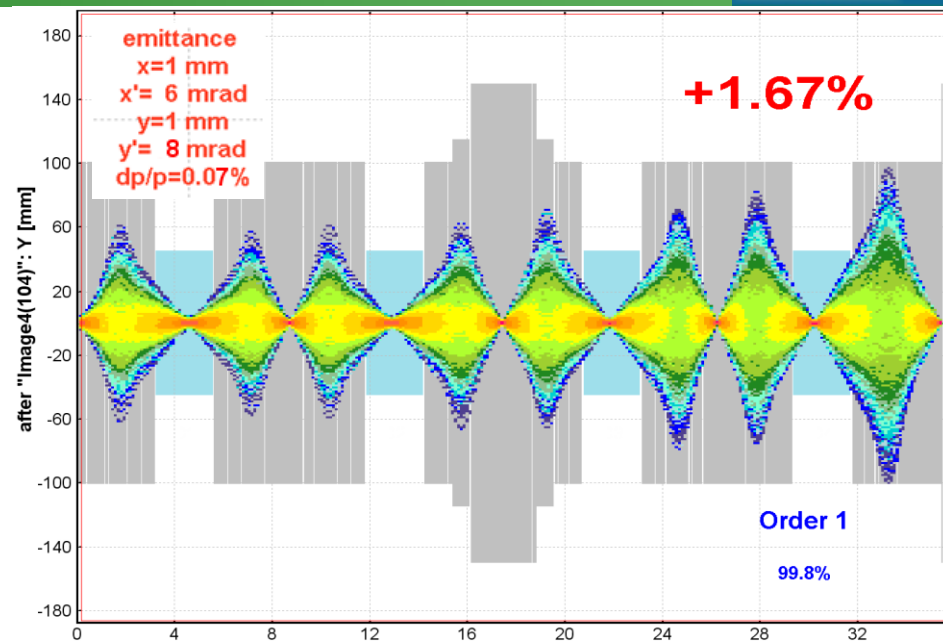
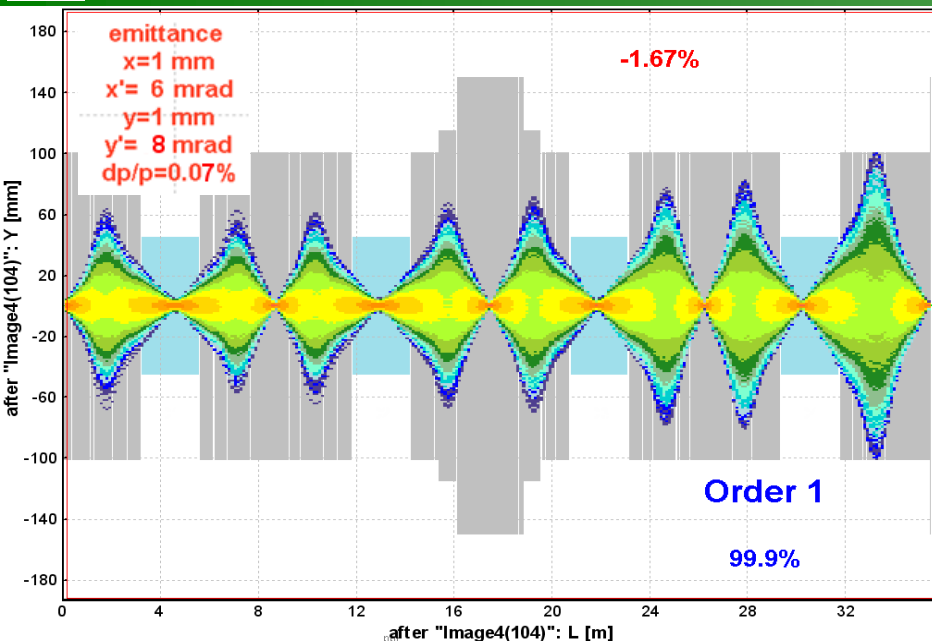




Brho	dp/pp	1st order	2order
2.900	-3.33%	0	0
2.910	-3.00%	0	0
2.920	-2.67%	2.2%	1.9%
2.925	-2.50%	51.2%	24.7%
2.930	-2.33%	97.6%	40.6%
2.940	-2.00%	99.9%	48.9%
2.950	-1.67%	99.9%	57.7%
2.970	-1.00%	99.9%	81.5%
2.985	-0.50%	99.8%	95.1%
3.000	0.00%	99.9%	99.8%
3.015	0.50%	100.0%	100.0%
3.030	1.00%	100.0%	100.0%
3.040	1.33%	100.0%	100.0%
3.050	1.67%	99.8%	99.8%
3.060	2.00%	99.9%	100.0%
3.070	2.33%	97.3%	93.7%
3.075	2.50%	51.3%	33.8%
3.080	2.67%	2.6%	0.7%
3.090	3.00%	0	0

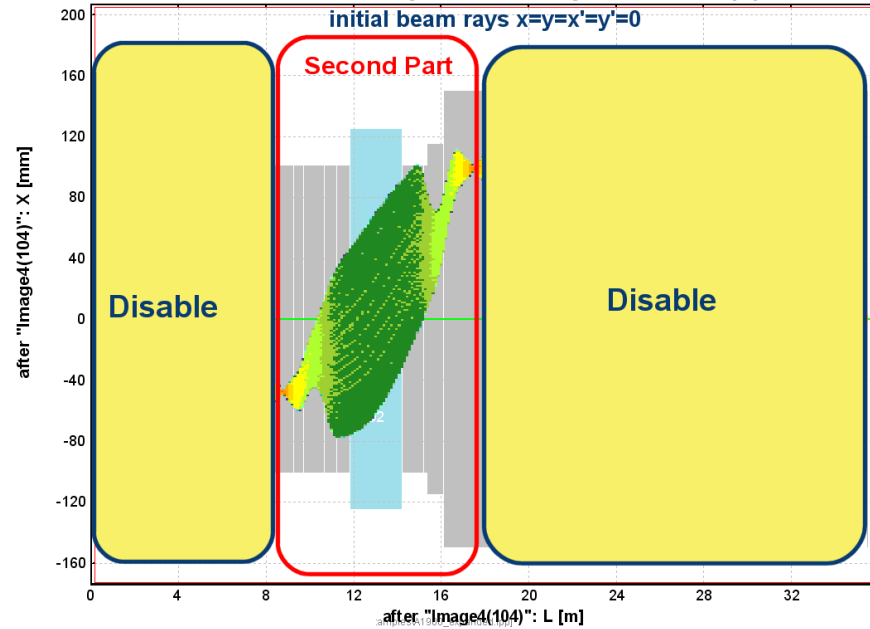


emittance
 $x=1$ mm
 $x'=6$ mrad
 $y=1$ mm
 $y'=8$ mrad
 $dp/p=0.07\%$

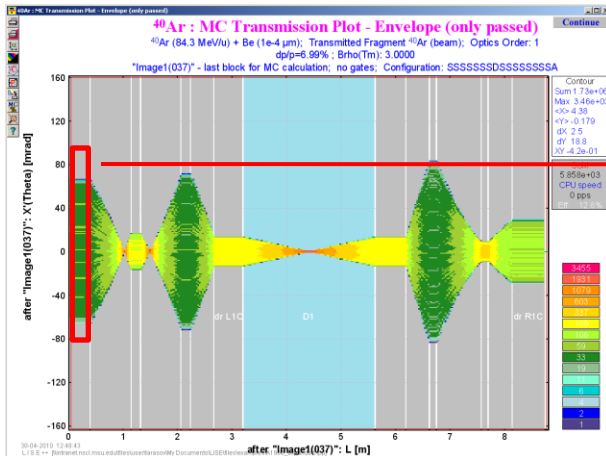


A1900 contains four dispersive blocks, whose angular acceptances are used in LISE++ calculations with the A1900 standard configuration

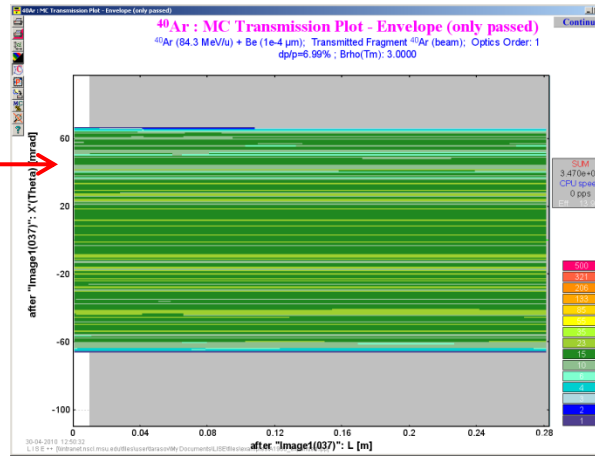
to obtain an angular acceptance of the second part of the fragment separator
 beam emittance $x=y=0.01$ mm, $x'=y'=100$ mrad, $dp/p=0.0\%$



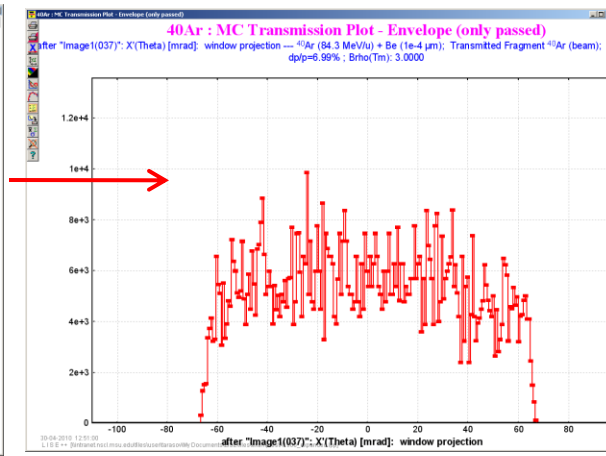
Envelope for selected Angle



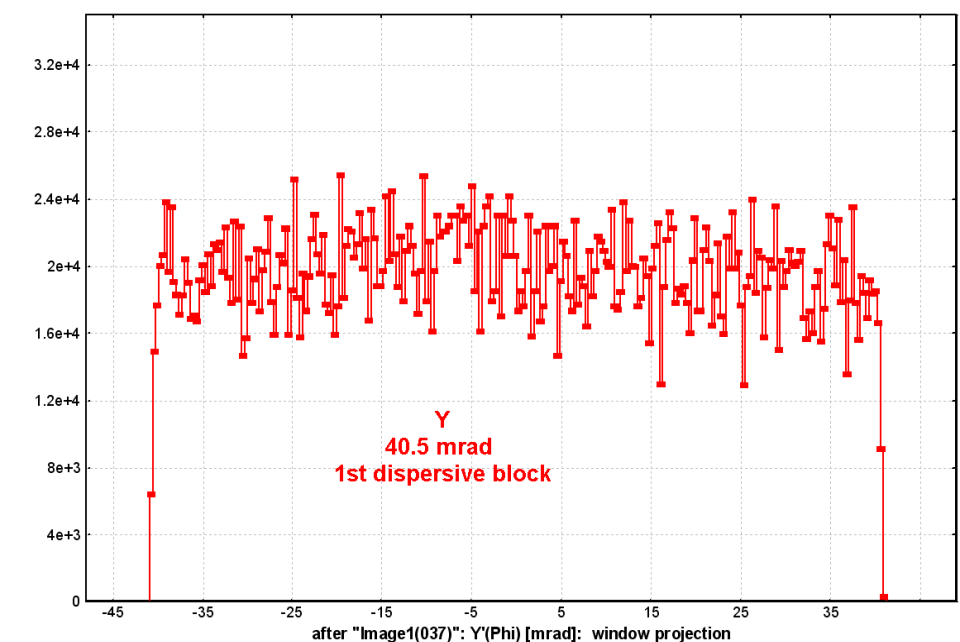
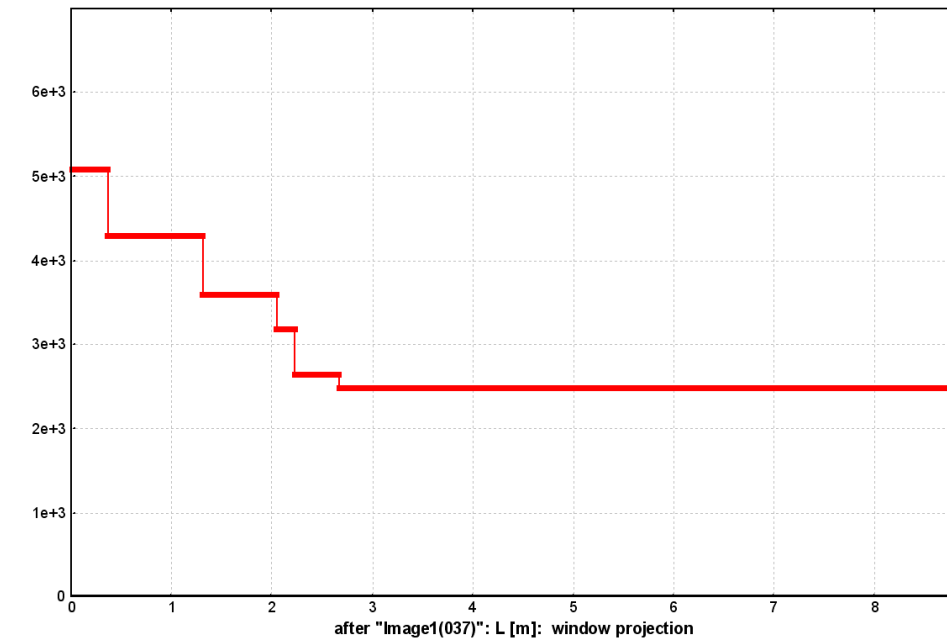
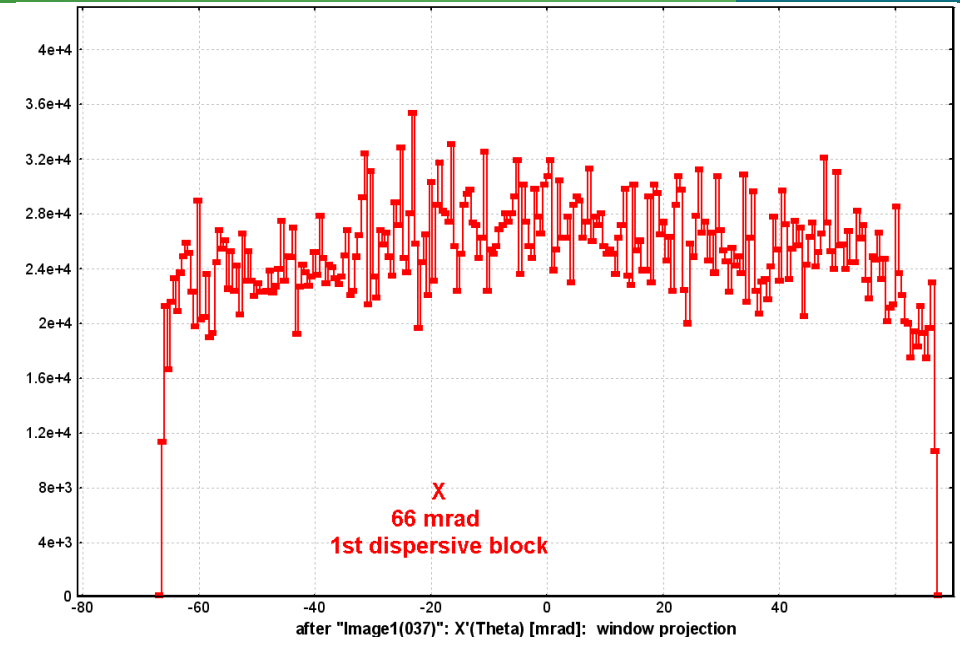
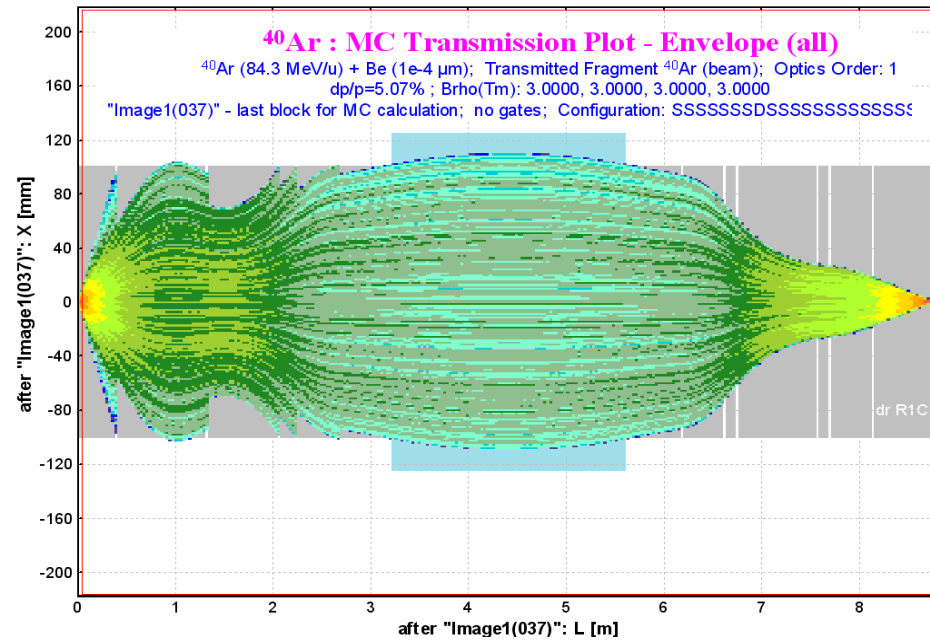
Zoom of first region



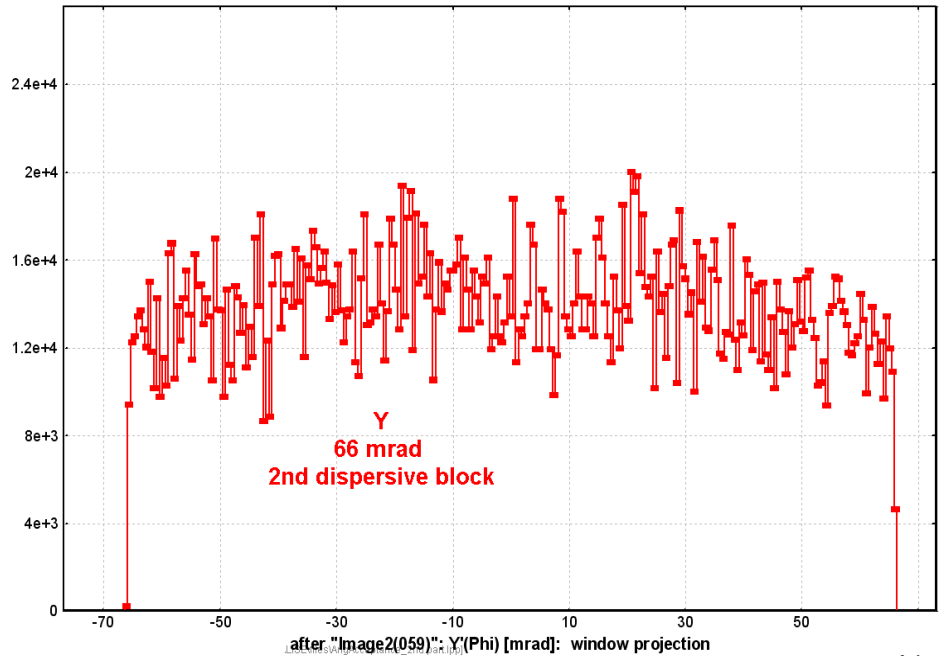
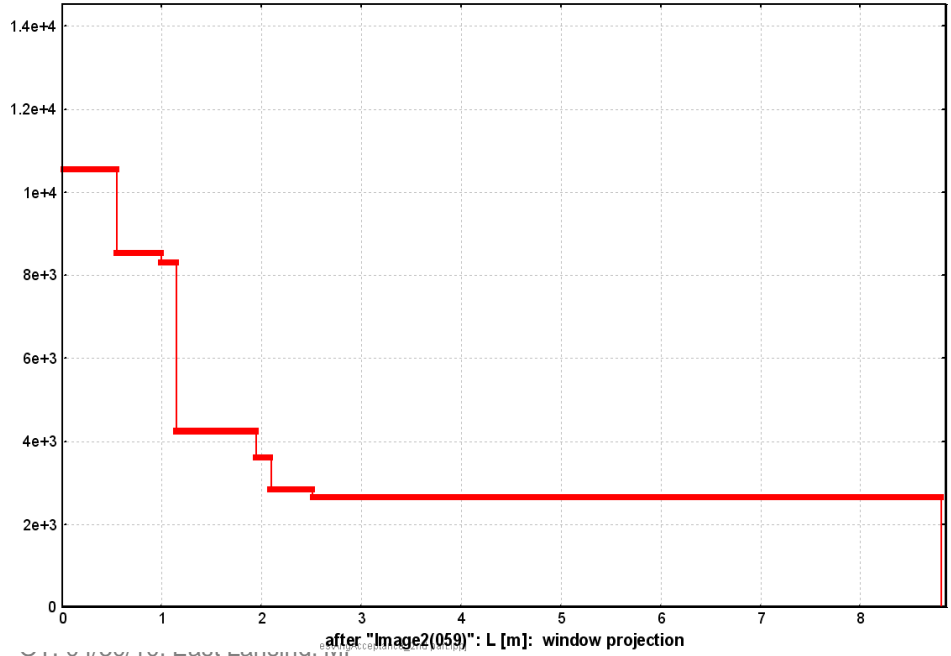
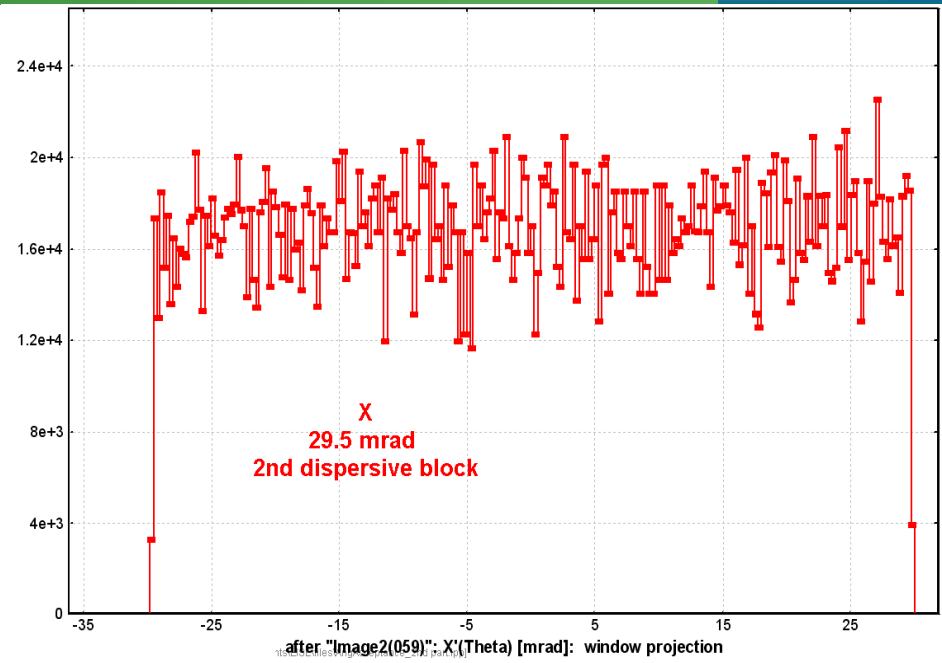
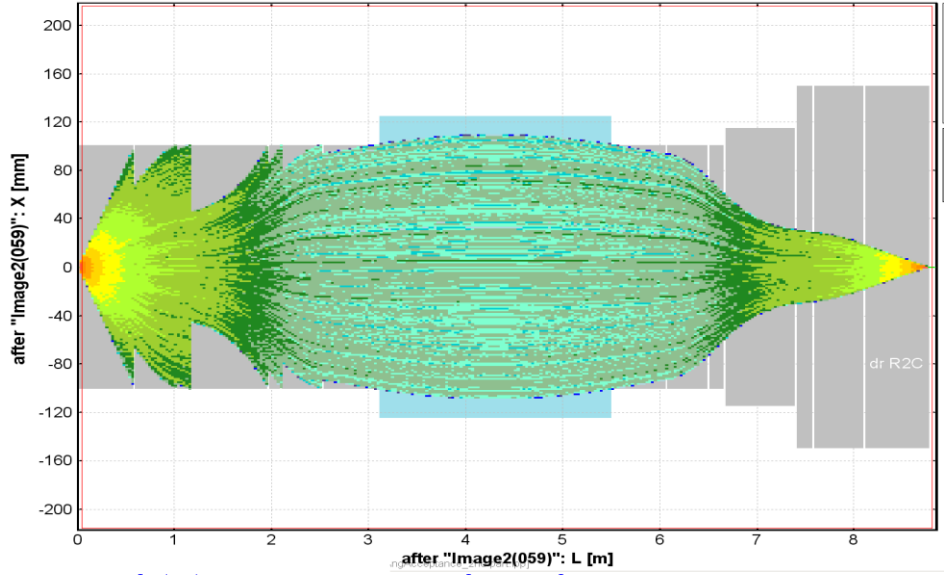
Projection on Y-axis



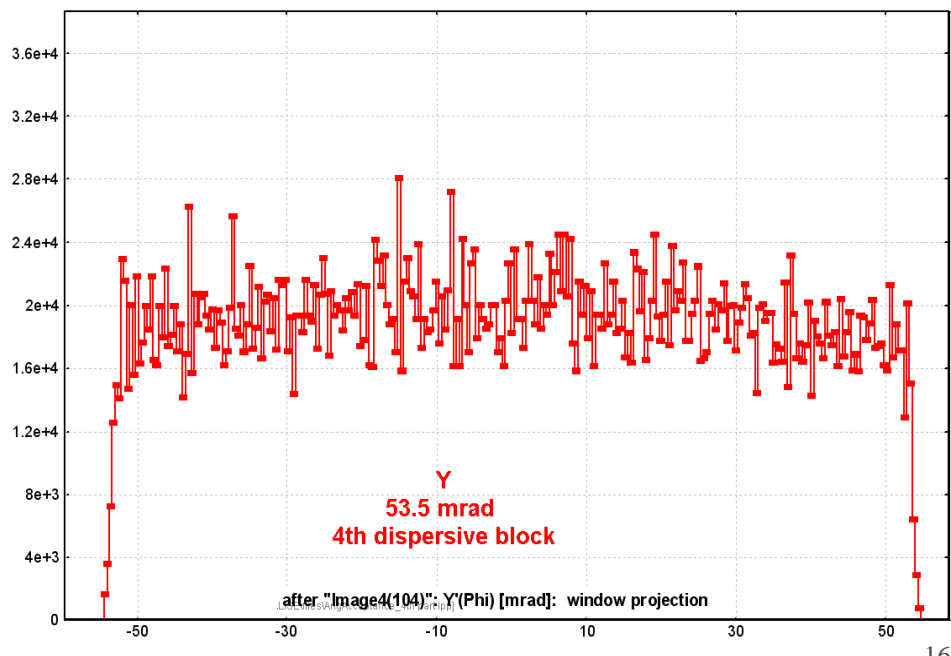
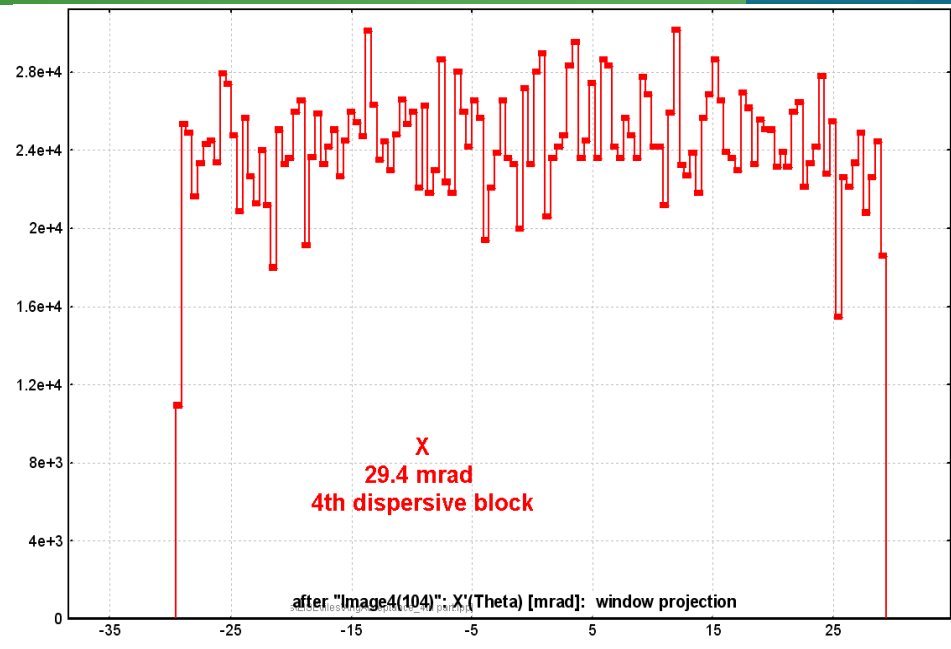
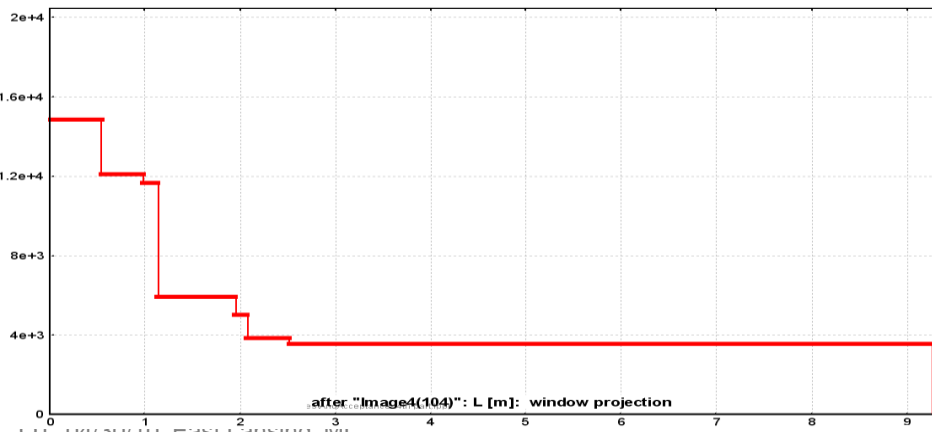
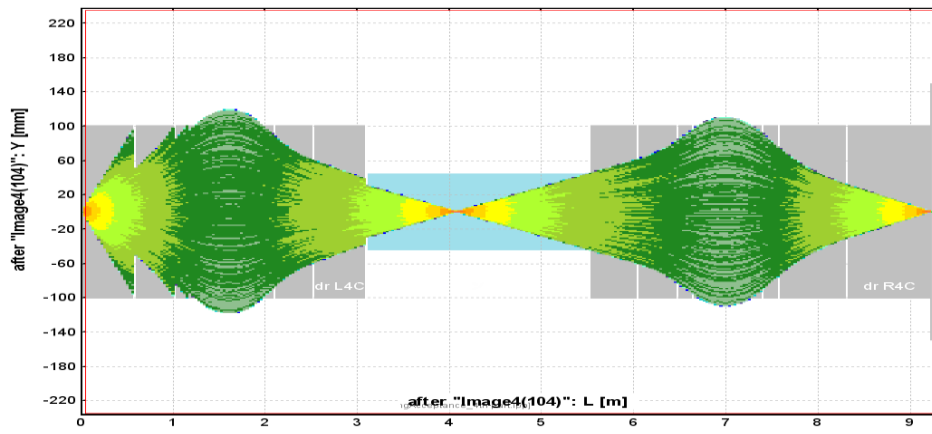
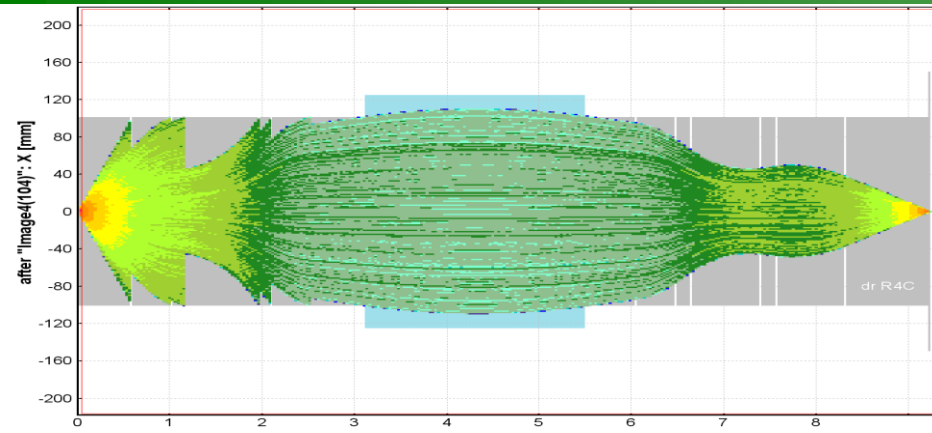
Angular Acceptance: 1st dispersive block



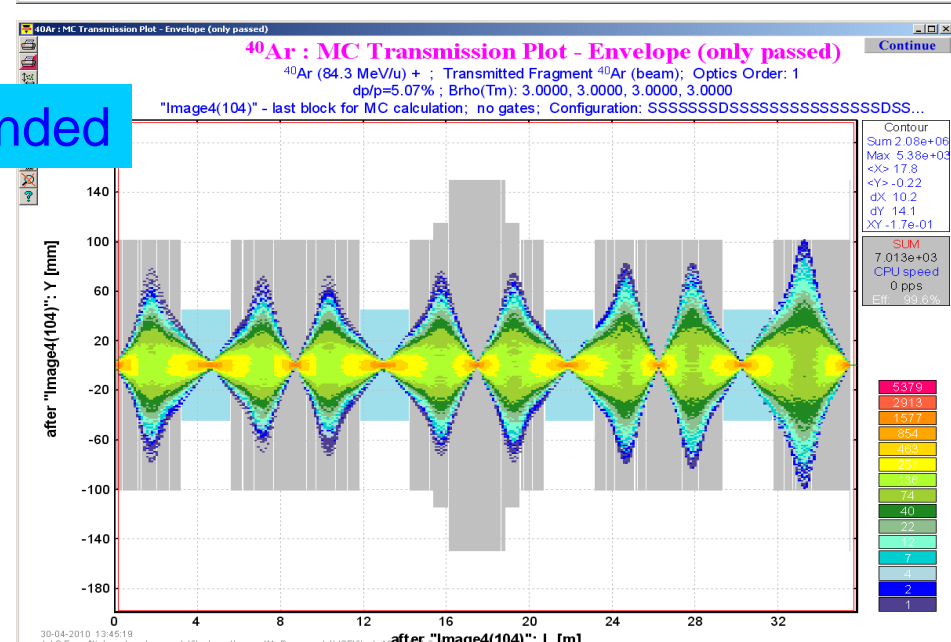
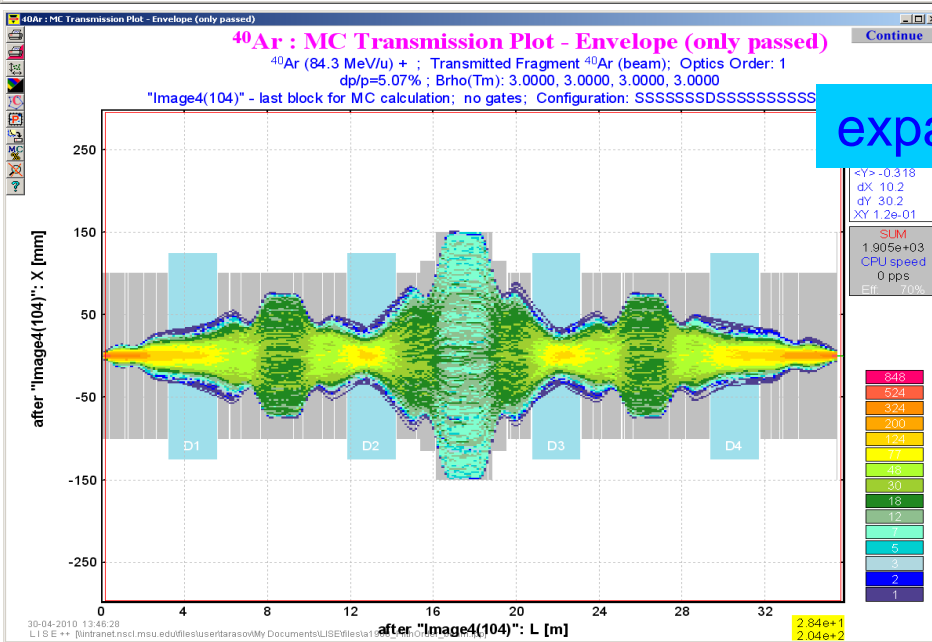
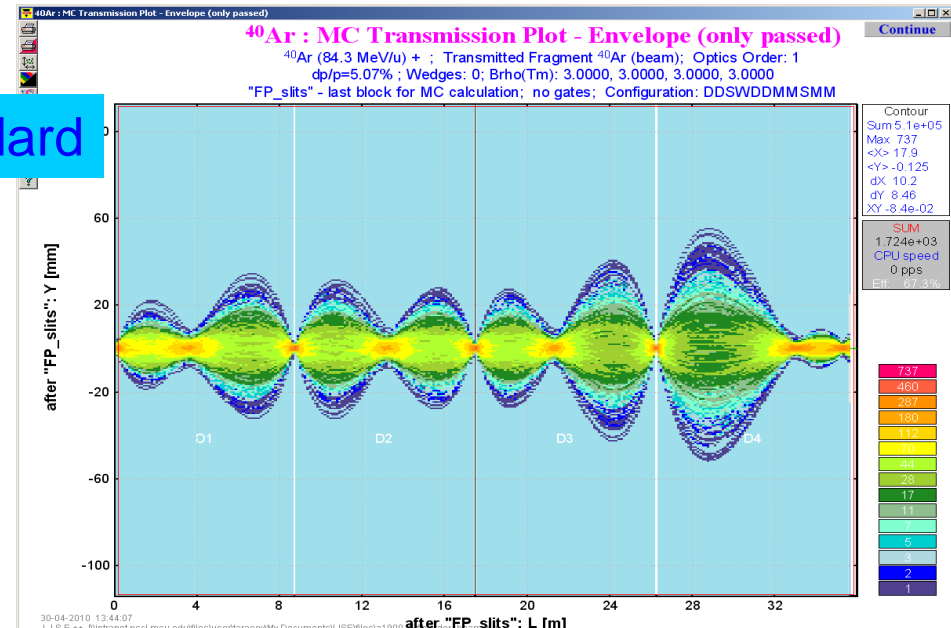
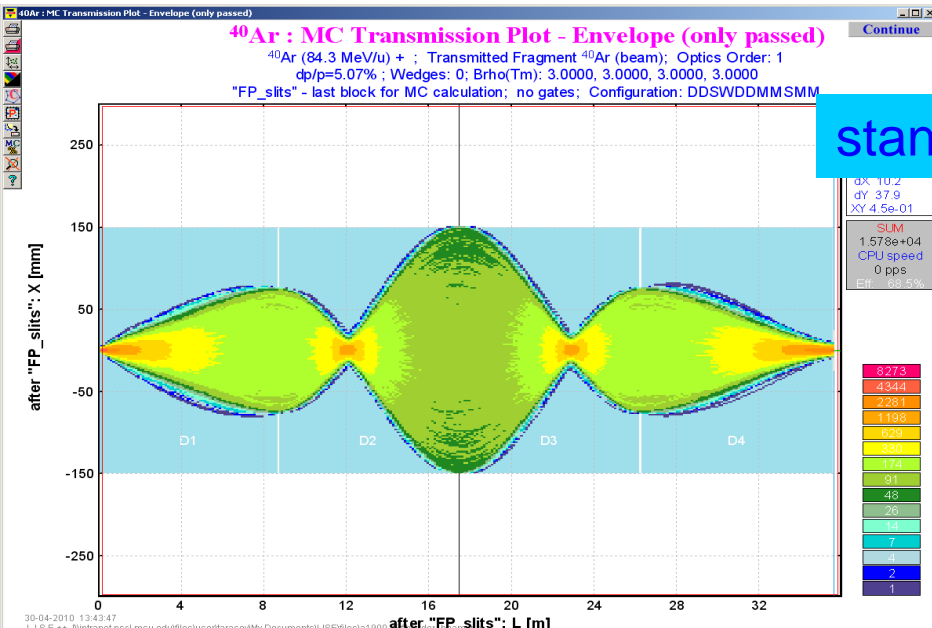
⁴⁰Ar : MC Transmission Plot - Envelope (all)
⁴⁰Ar (0.12 MeV/u) + Be (1e-4 μm); Transmitted Fragment ⁴⁰Ar (beam); Optics Order: 1
 dp/p=6.47% ; Brho(Tm): 3.0000 3.0000 3.0000
 "Image2(059)" - last block for MC calculation; no gates; Configuration: SSSSSSSDSSSSSSSSSSSSSSSSSS



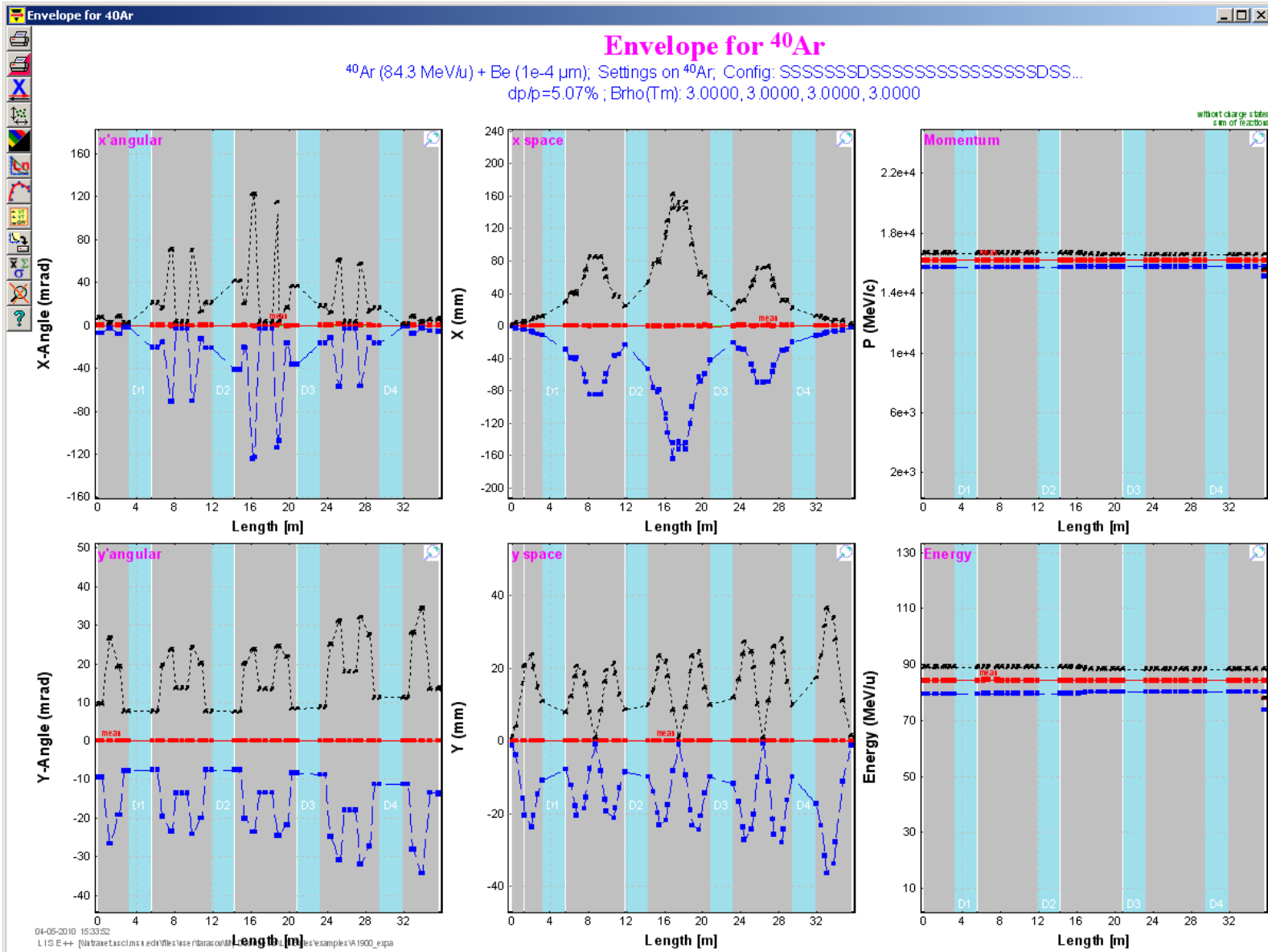
Angular Acceptance: 4th dispersive block



Compare standard and expanded version



Initial Phase space: ± 6 mrad (x), ± 8 mrad (y), $\pm 2.5\%$ (dp/p)



Initial Phase space: ± 60 mrad (x), ± 40 mrad (y), $\pm 2.5\%$ (dp/p)

