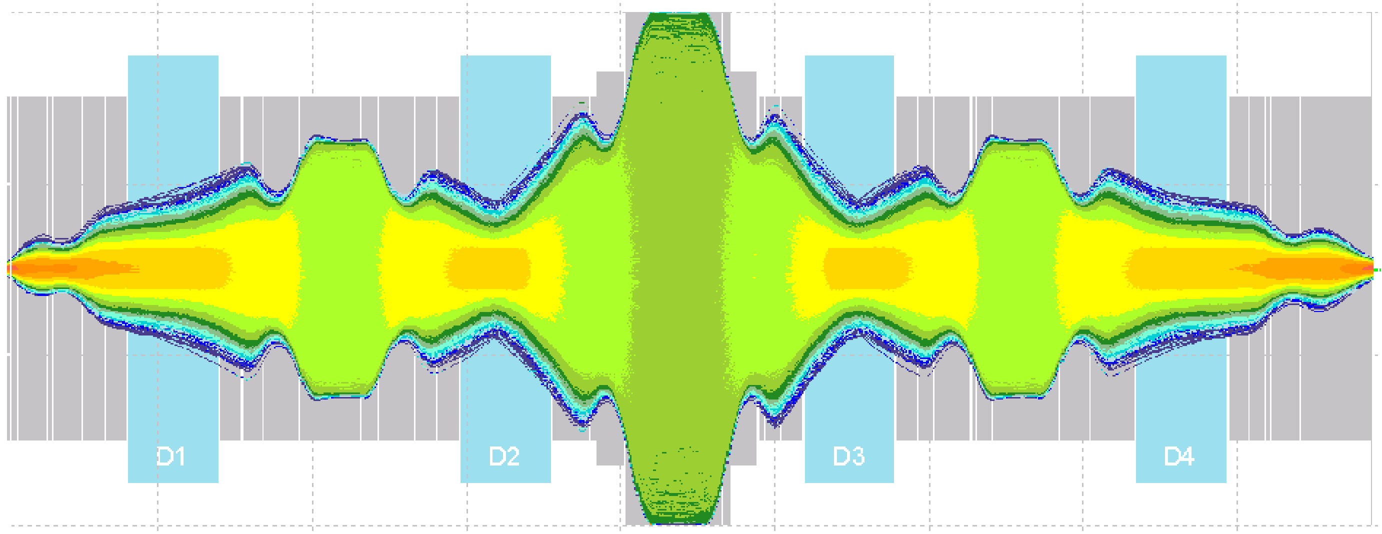
A1900 expanded configuration

version 9.0.39

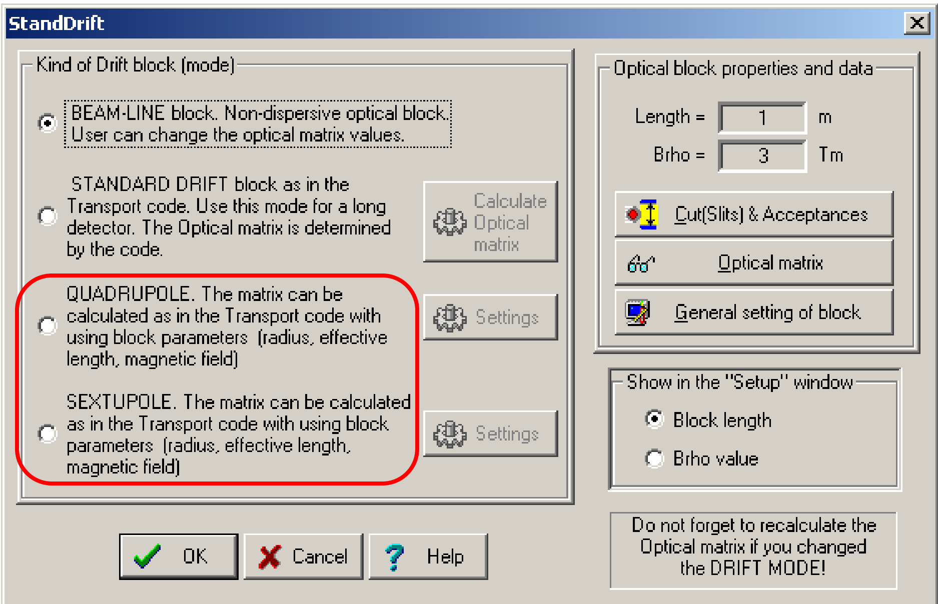


Contents:

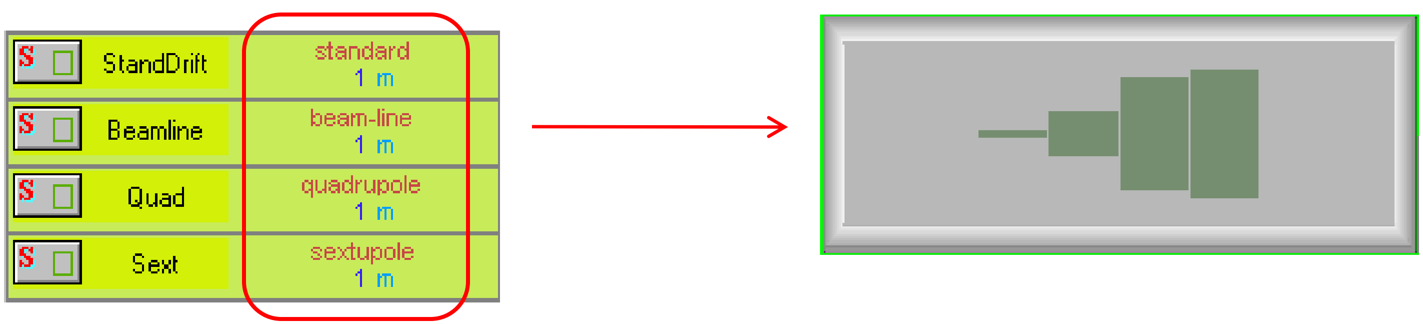
- *Drift block: Quadrupole and Sextupole options*
- *Construction of the A1900 expanded configuration*
- *Momentum acceptance*
- *Angular acceptance*
- *Comparison of different A1900 configurations*
- *Expanded configuration vs. Distribution method*

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.nscl.msu/edu/lise

Drift block



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).

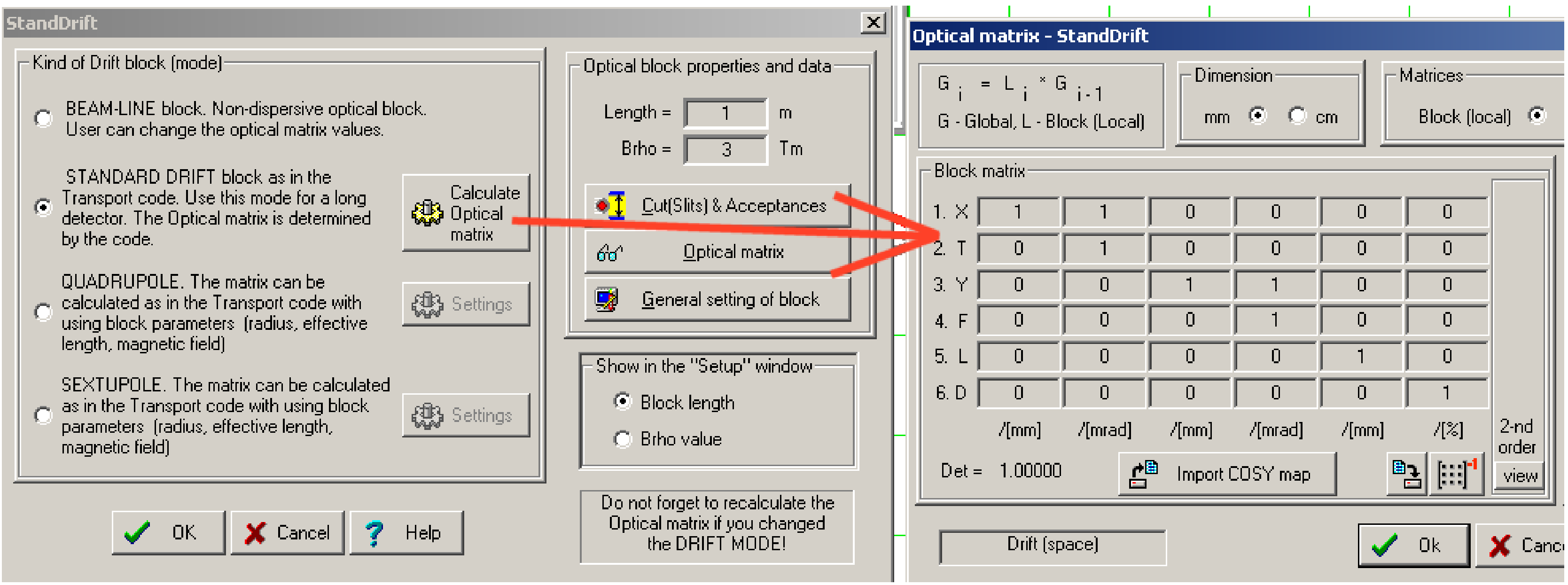


DRIFT block: Beam-line, Standard drift

DRIFT block:

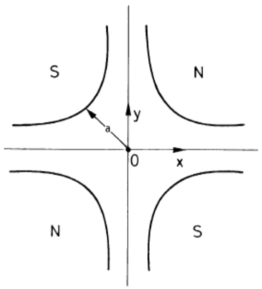
Charge state is not attributed to this optical block.
Non-dispersive block

Beam-line : User can change the optical matrix values.
Do not enter DISPERSON coefficients!!



DRIFT block: Quadrupole

"Transport"



QUADRUPOLE

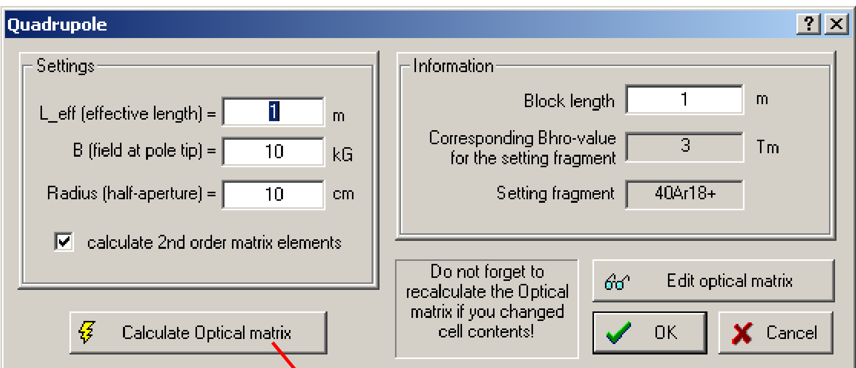
First-order quadrupole matrix

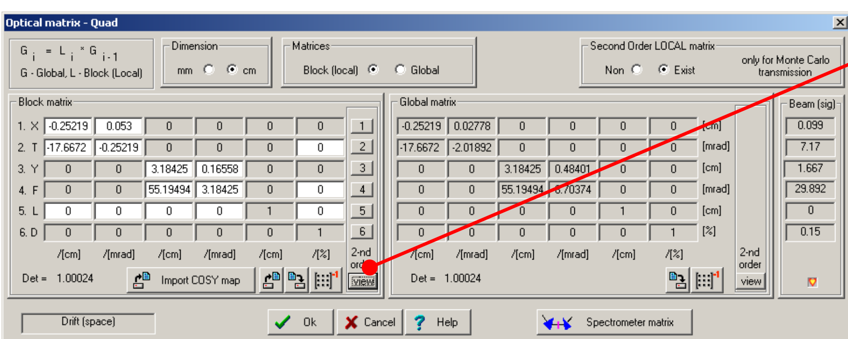
$$\begin{bmatrix} \cos k_q L & \frac{1}{k_q}\sin k_q L & 0 & 0 & 0 & 0 \\ -k_q \sin k_q L & \cos k_q L & 0 & 0 & 0 & 0 \\ 0 & 0 & \cosh k_q L & \frac{1}{k_q}\sinh k_q L & 0 & 0 \\ 0 & 0 & k_q \sinh k_q L & \cosh k_q L & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

$k_q^2 = (B_0/a)(1/B\rho_0)$, 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)

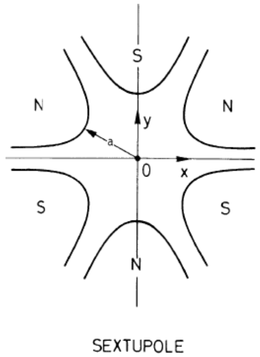


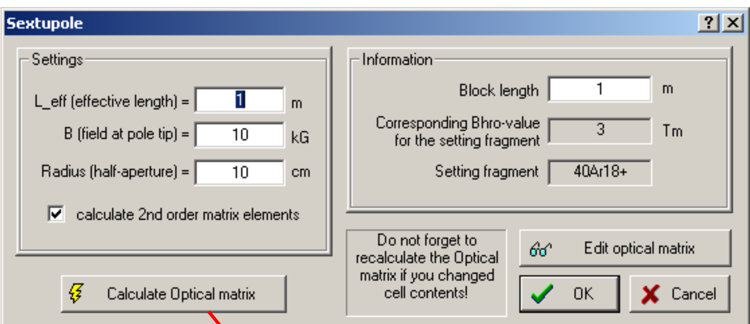


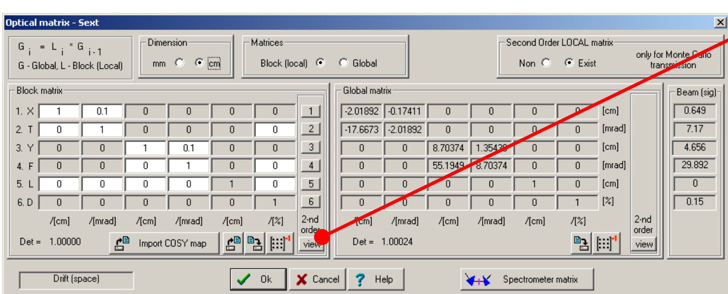

```
Block: "Quad"   Matrices: "LOCAL"
Block:  "Quad"     Matrices:  "LOCAL"
                                                        transport format [cm-mrad]

                         * TRANSFORM 1 *

 1 [X]:   -2.5219e-01  +5.3000e-02  0            0            0            0
 2 [T]:   -1.7667e+01  -2.5219e-01  0            0            0            0
 3 [Y]:    0            0           +3.1843e+00  +1.6558e-01  0            0
 4 [F]:    0            0           +5.5195e+01  +3.1843e+00  0            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:    0
 1   2:    0            0
 1   3:    0            0            0
 1   4:    0            0            0            0
 1   5:    0            0            0            0            0
 1   6:   +8.8336e-03  +3.9111e-04  0            0            0            0

 2   1:    0
 2   2:    0            0
 2   3:    0            0            0
 2   4:    0            0            0            0
 2   5:    0            0            0            0            0
 2   6:   +4.6304e-02  +8.8336e-03  0            0            0            0

 3   1:    0
 3   2:    0            0
 3   3:    0            0            0
 3   4:    0            0            0            0
 3   5:    0            0            0            0            0
 3   6:    0            0           -2.7597e-02  -7.6420e-04  0            0

 4   1:    0
 4   2:    0            0
 4   3:    0            0            0
 4   4:    0            0            0            0
 4   5:    0            0            0            0            0
 4   6:    0            0           -8.0668e-01  -2.7597e-02  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
```

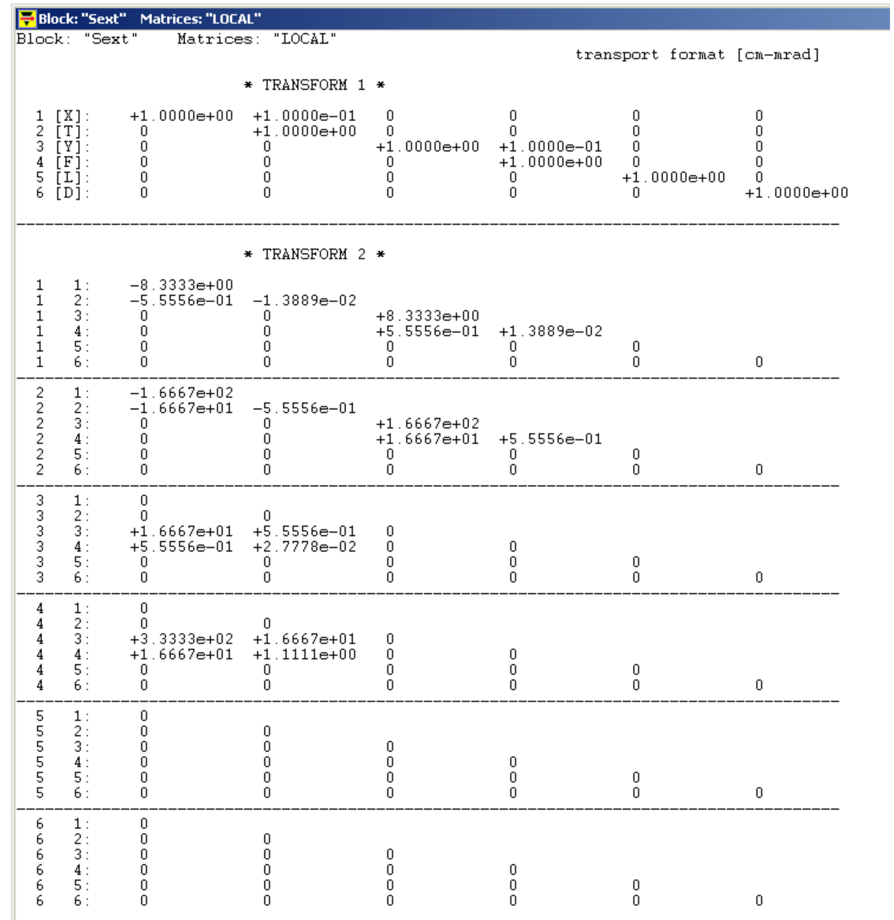
DRIFT block: Sextupole

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








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

Construction of the A1900 expanded configuration


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

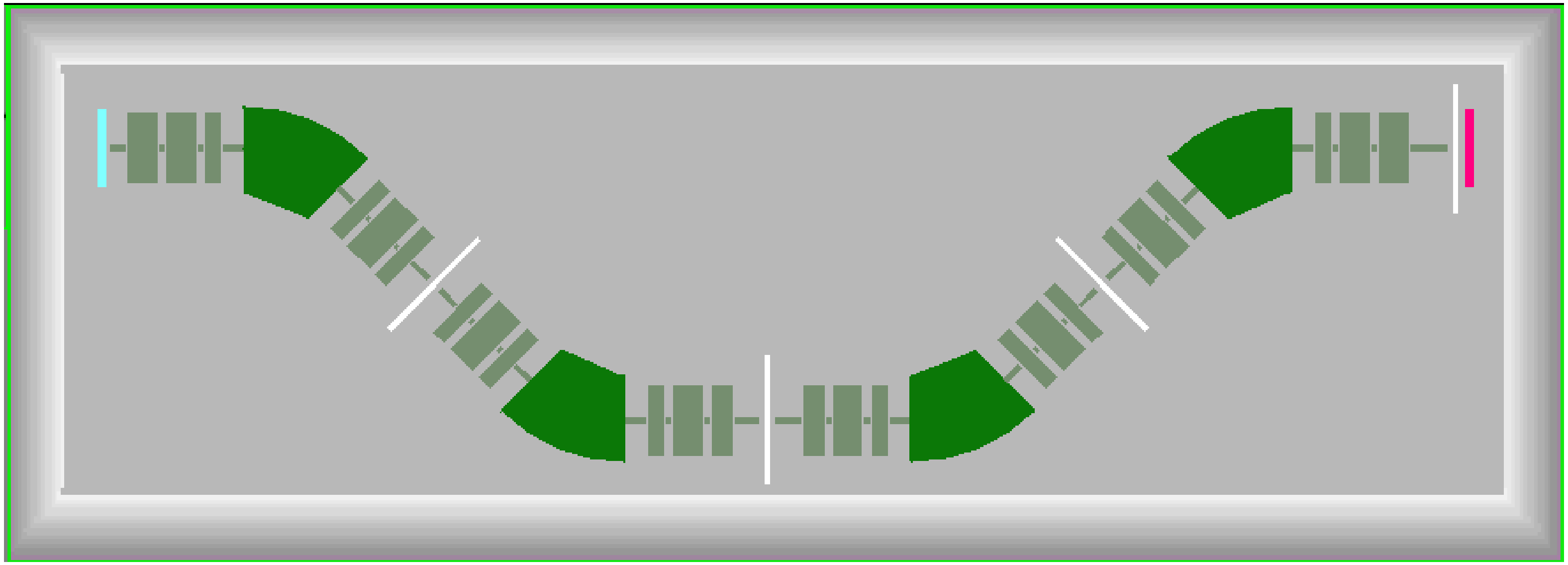
BlockStructure = TSSSSSSDSSSSSSSSSSSSSSDSSSSSSSSSSSSSSDSSSSSSSSSSSSSSDSSSSSSSSM

66 blocks!!

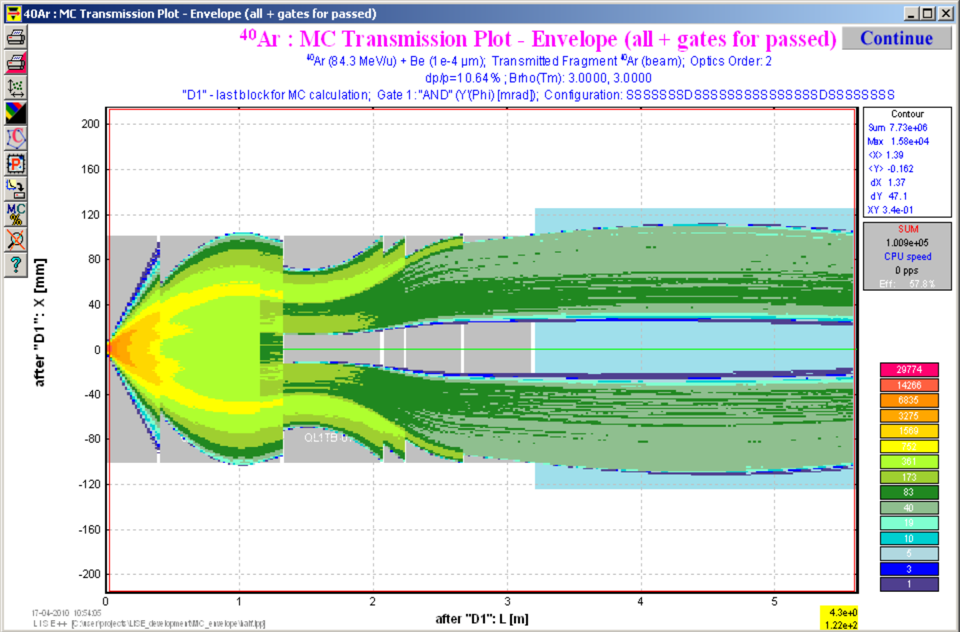
No angular acceptance values

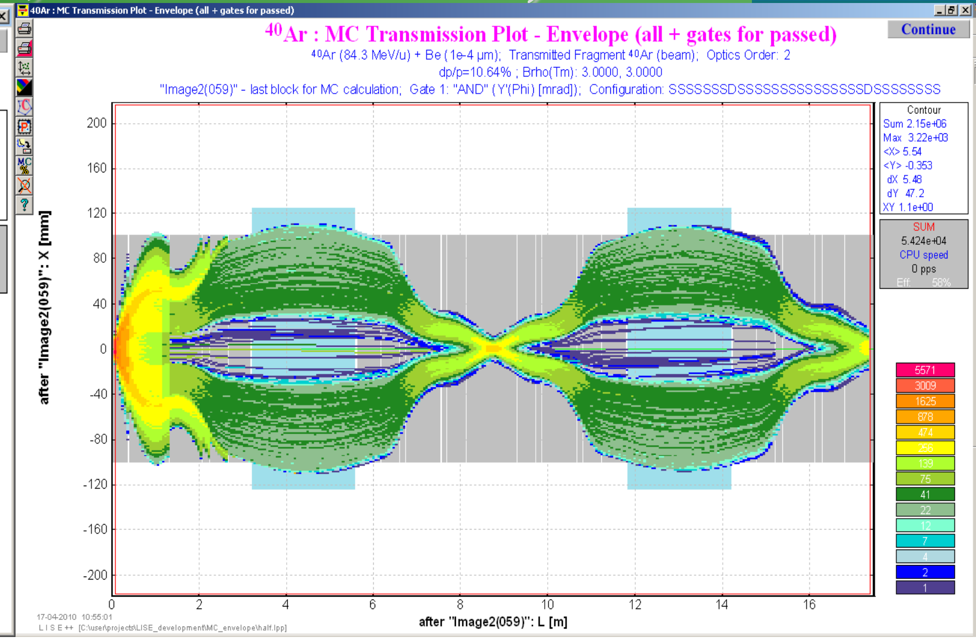
Dipole Block (Rot+Dip+Rot) matrices are taken from Transport calculations (1st order)

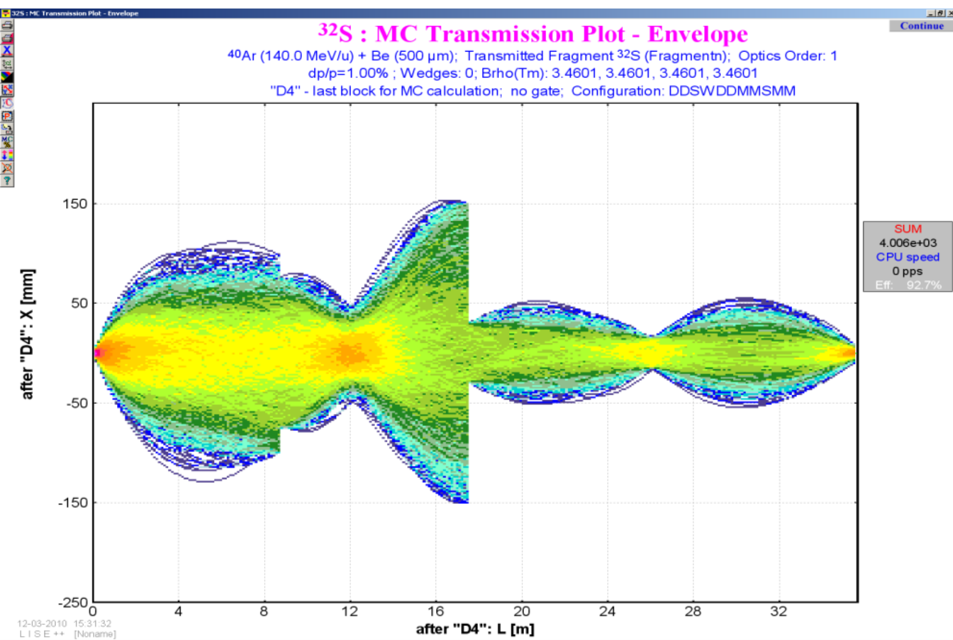
All drift block matrices have been calculated in LISE++

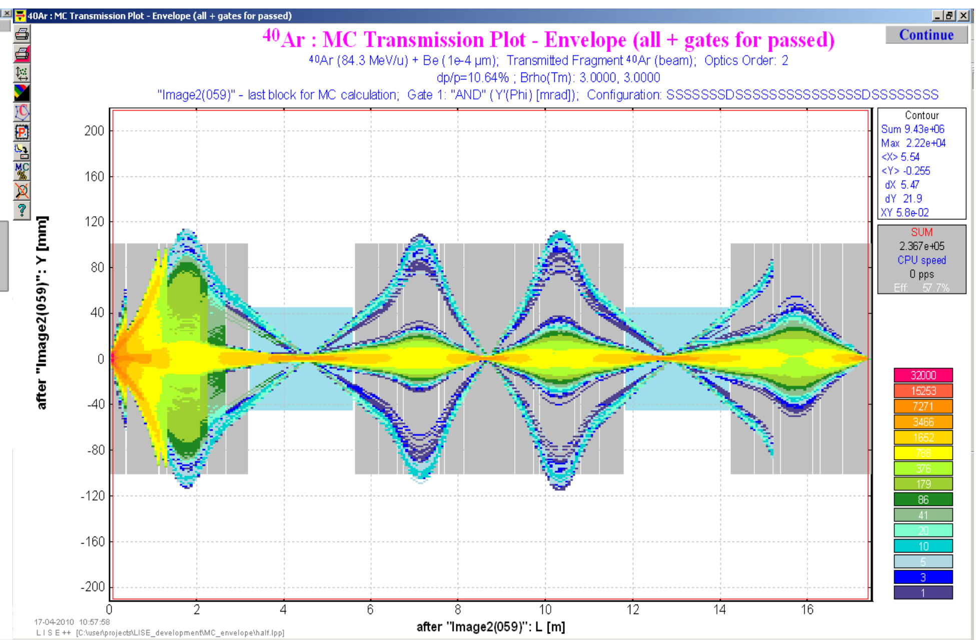


Examples of A1900 expanded configuration with MC envelope (different gates, emittances and so on)

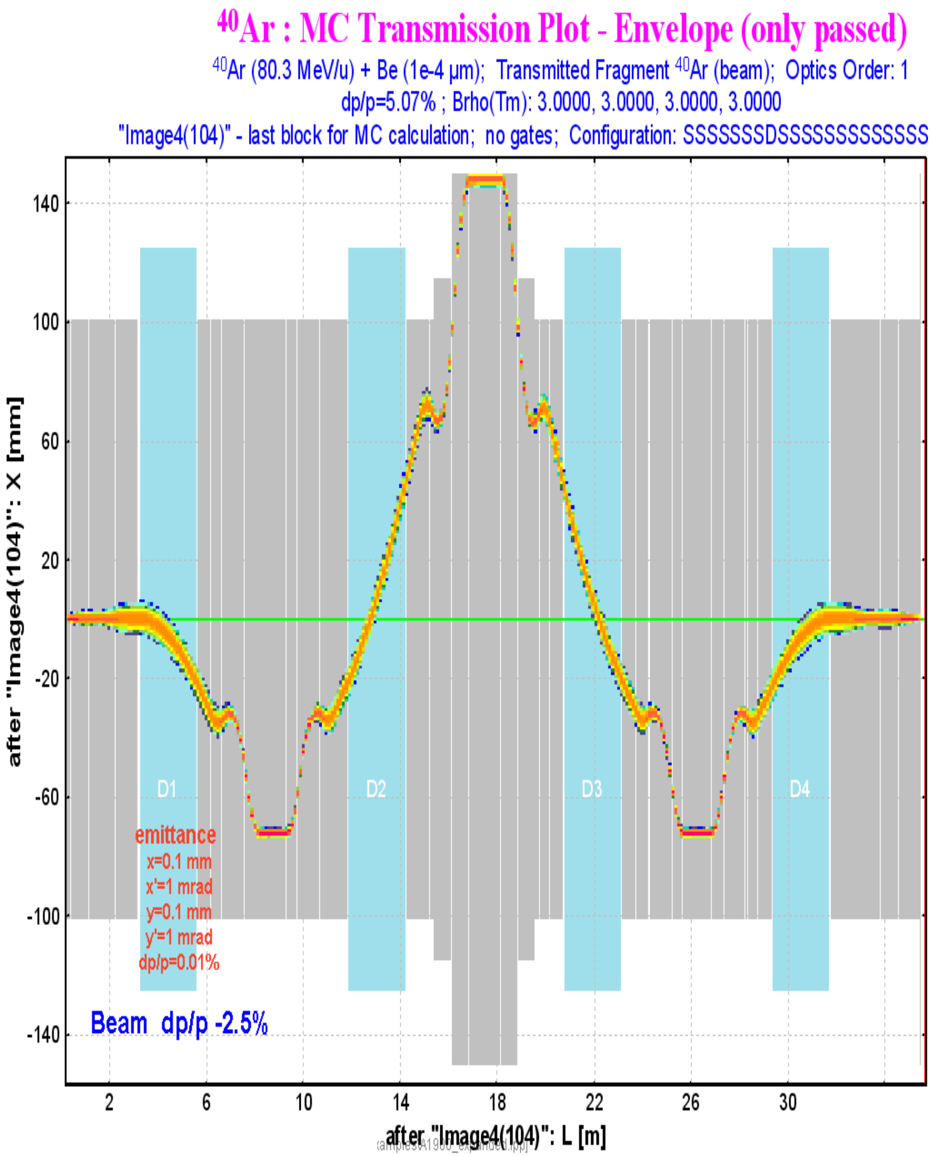


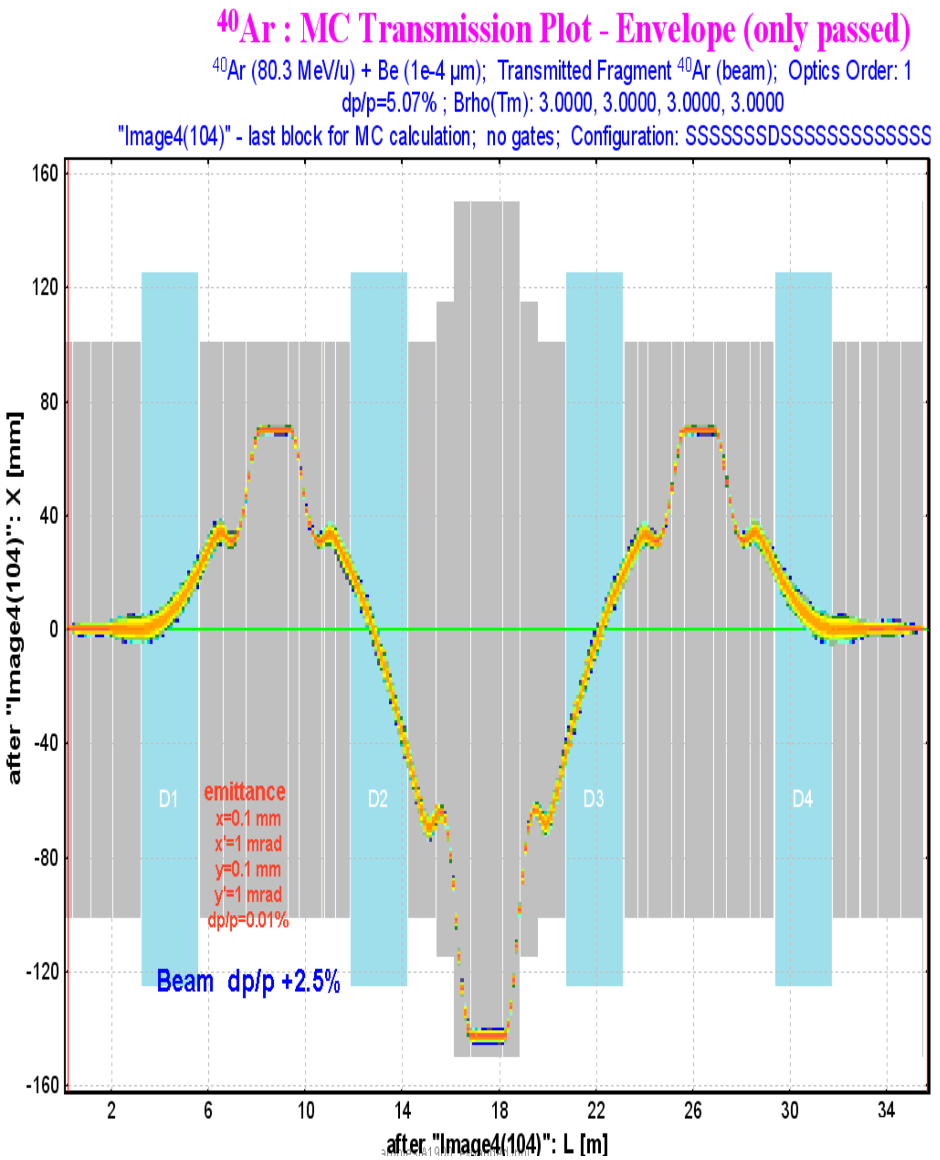




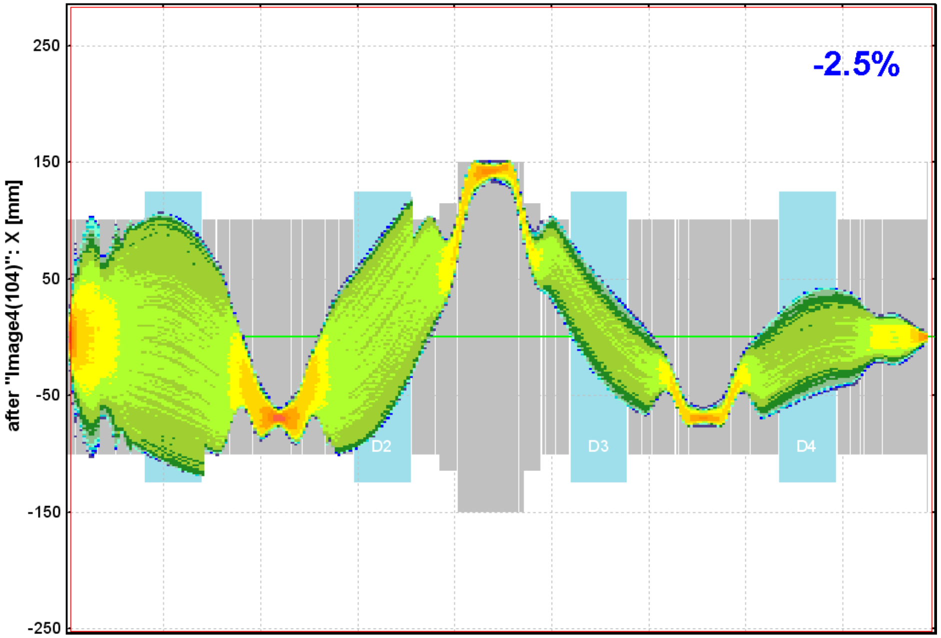


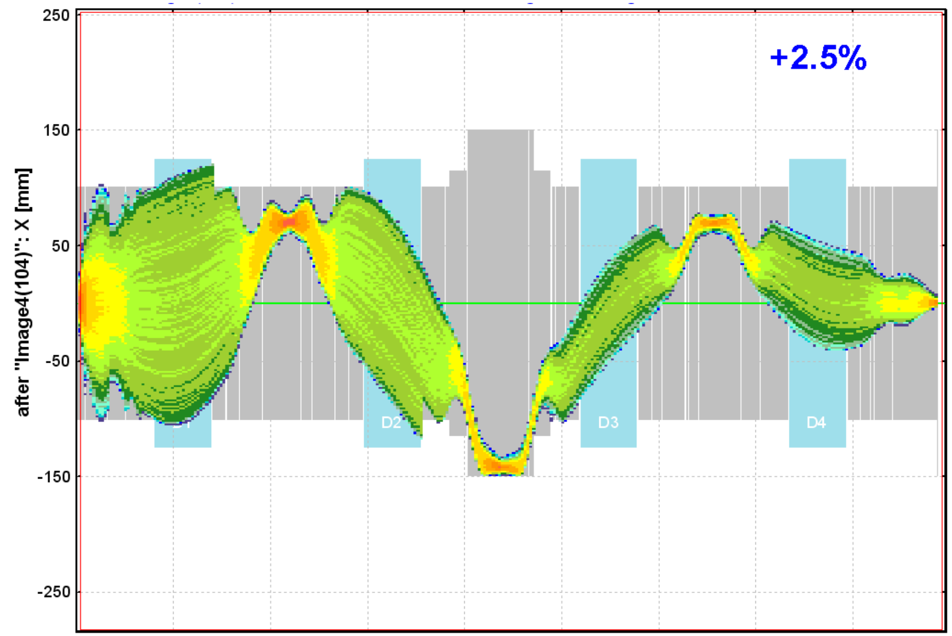
Momentum Acceptance

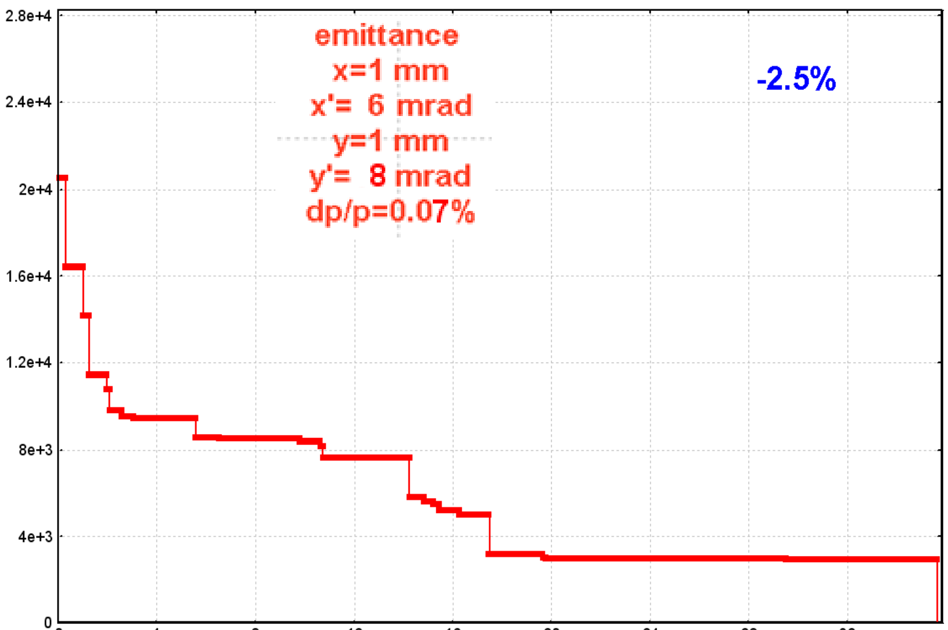


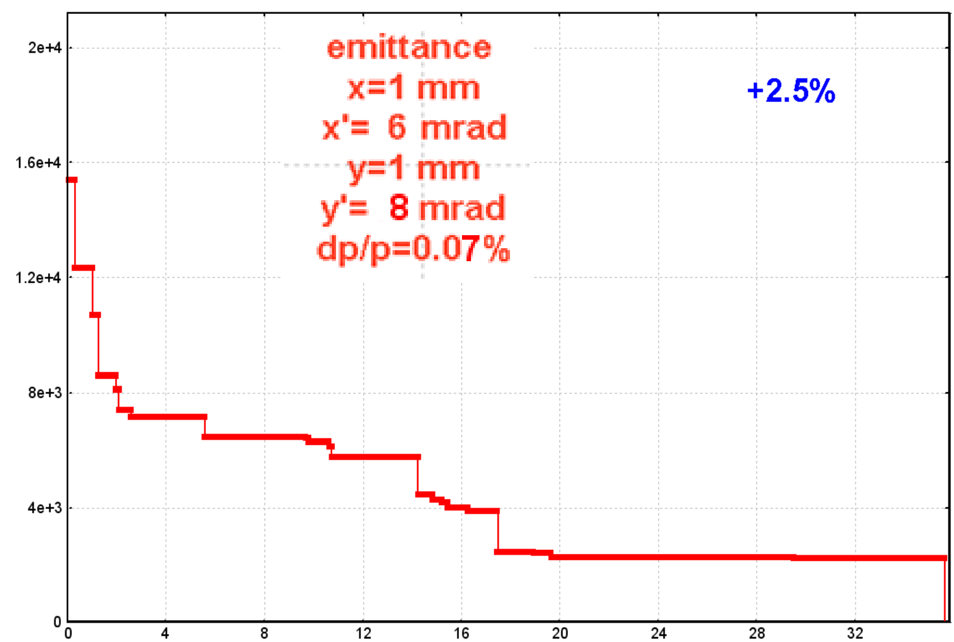


Momentum Acceptance



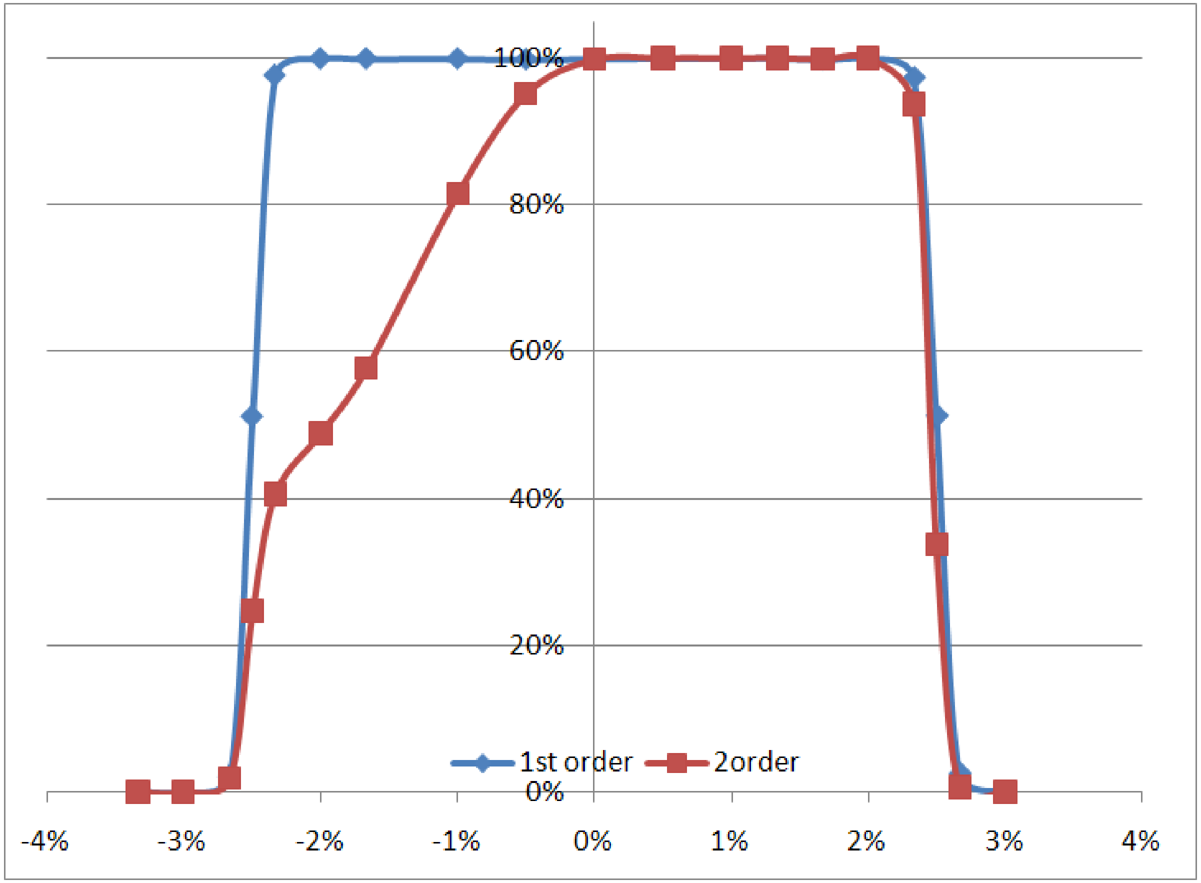






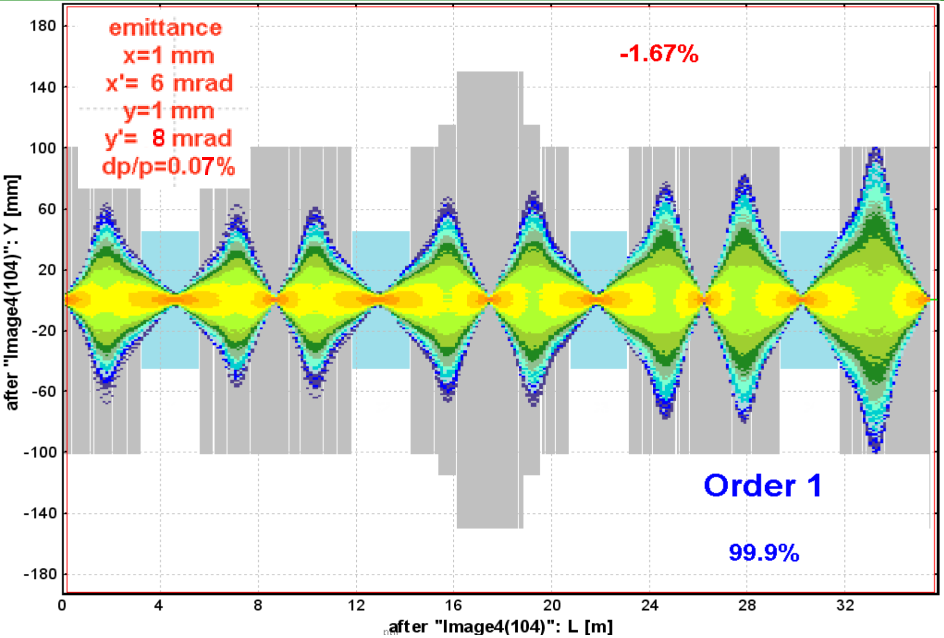
Momentum Acceptance

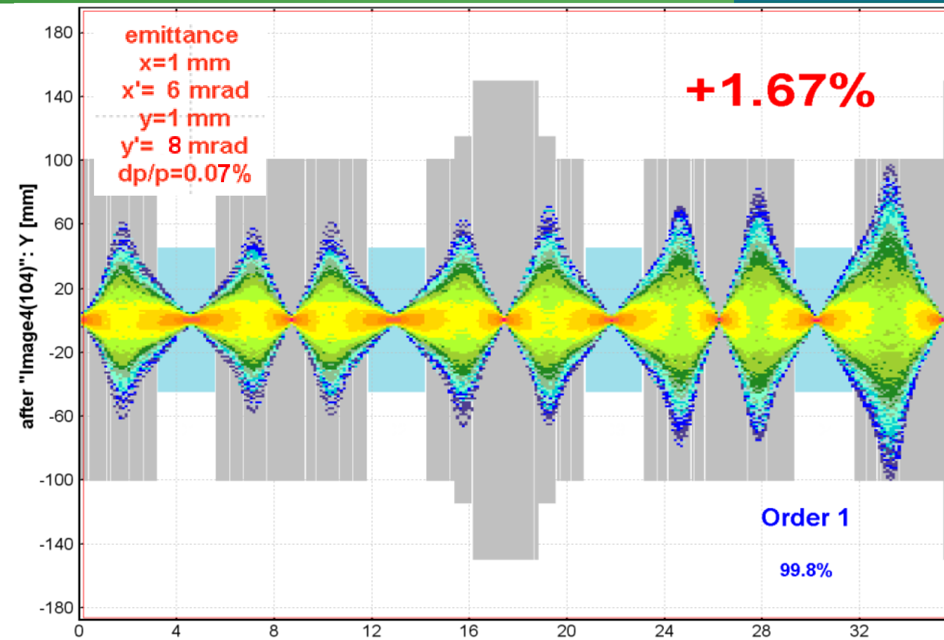
Brho	dp/pp	1st order	2order
2.900	-3.33%	0	0
2.910	-3.00%	0	0
2.920	-2.67%	2.2%	1.9%
2.925	-2.50%	51.2%	24.7%
2.930	-2.33%	97.6%	40.6%
2.940	-2.00%	99.9%	48.9%
2.950	-1.67%	99.9%	57.7%
2.970	-1.00%	99.9%	81.5%
2.985	-0.50%	99.8%	95.1%
3.000	0.00%	99.9%	99.8%
3.015	0.50%	100.0%	100.0%
3.030	1.00%	100.0%	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

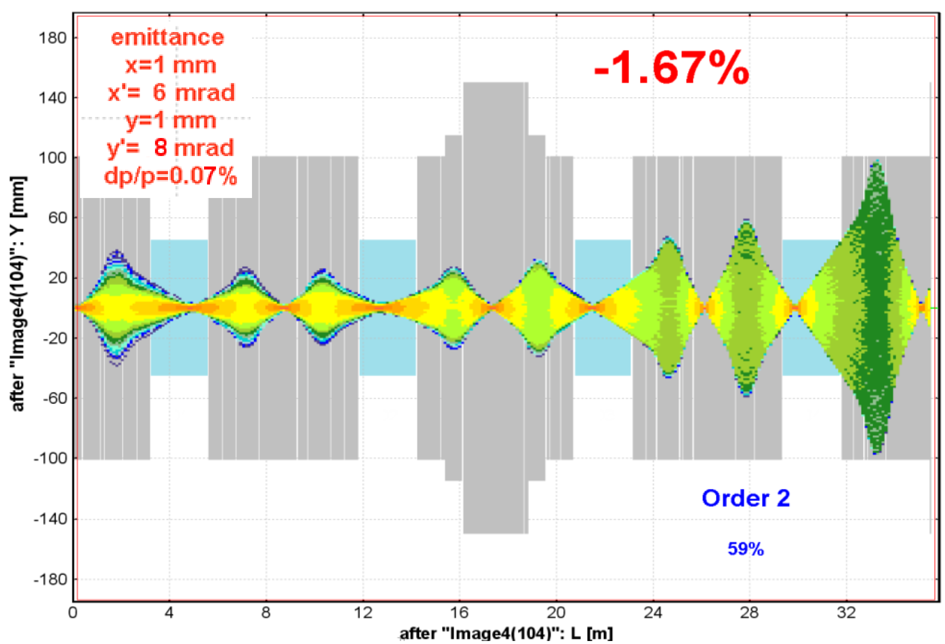


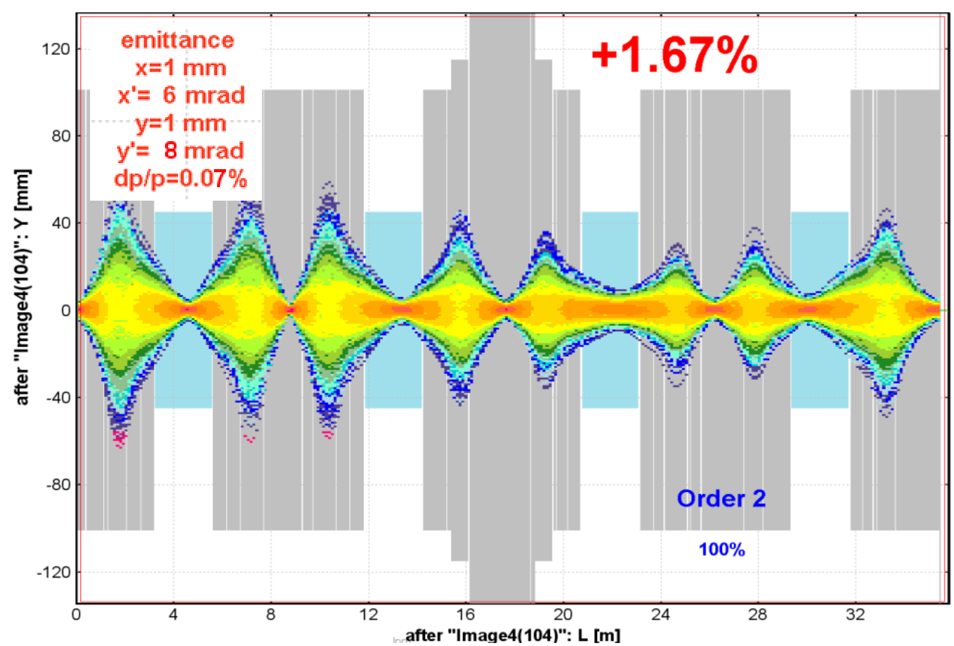
emittance
x=1 mm
x'= 6 mrad
y=1 mm
y'= 8 mrad
dp/p=0.07%

Momentum Acceptance



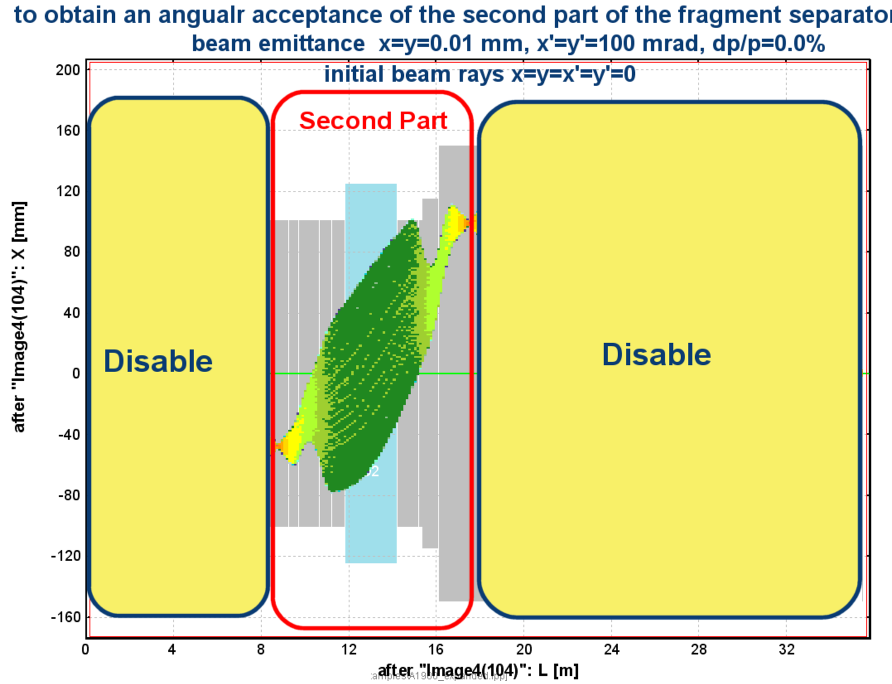




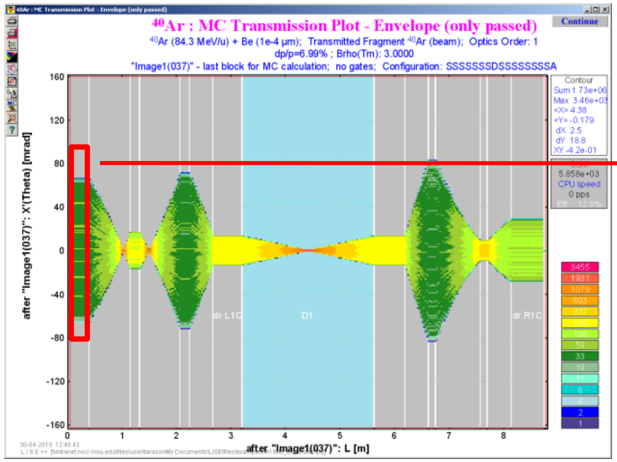


Angular Acceptance

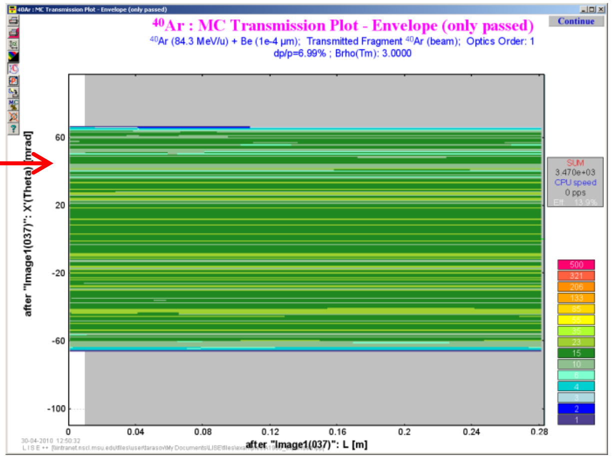
A1900 contains four dispersive blocks, whose angular acceptances are used in LISE++ calculations with the A1900 standard configuration



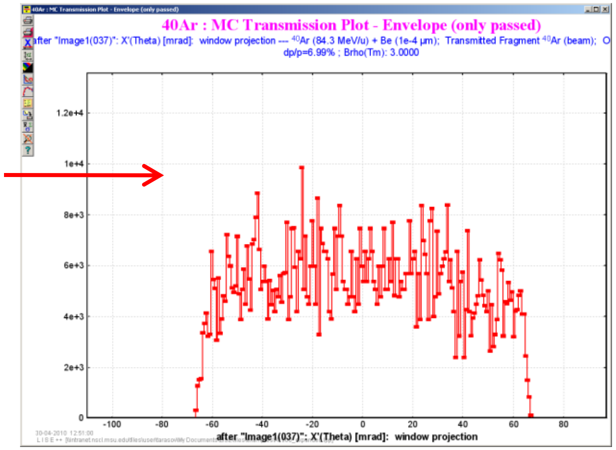
Envelope for selected Angle



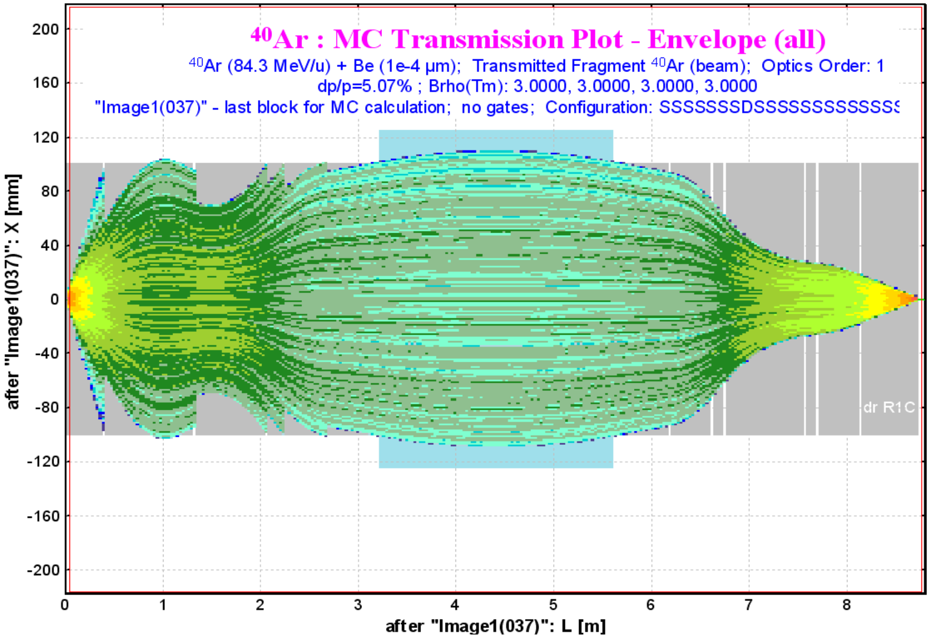
Zoom of first region

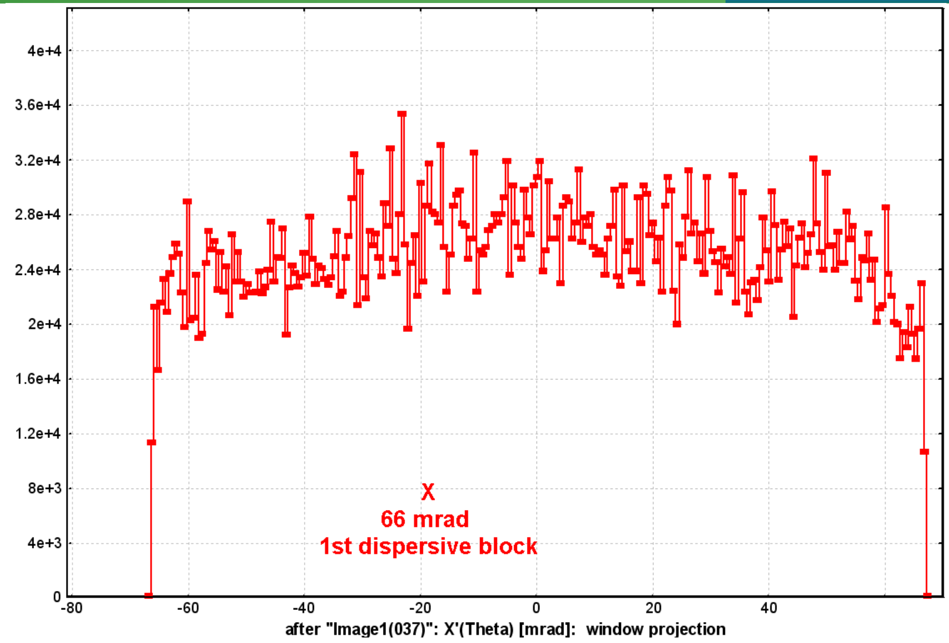


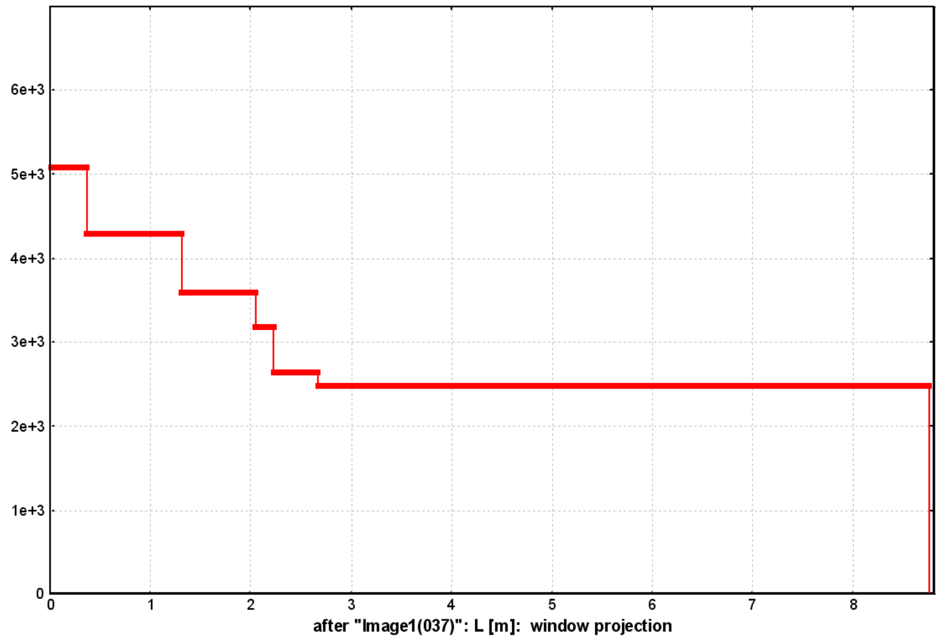
Projection on Y-axis

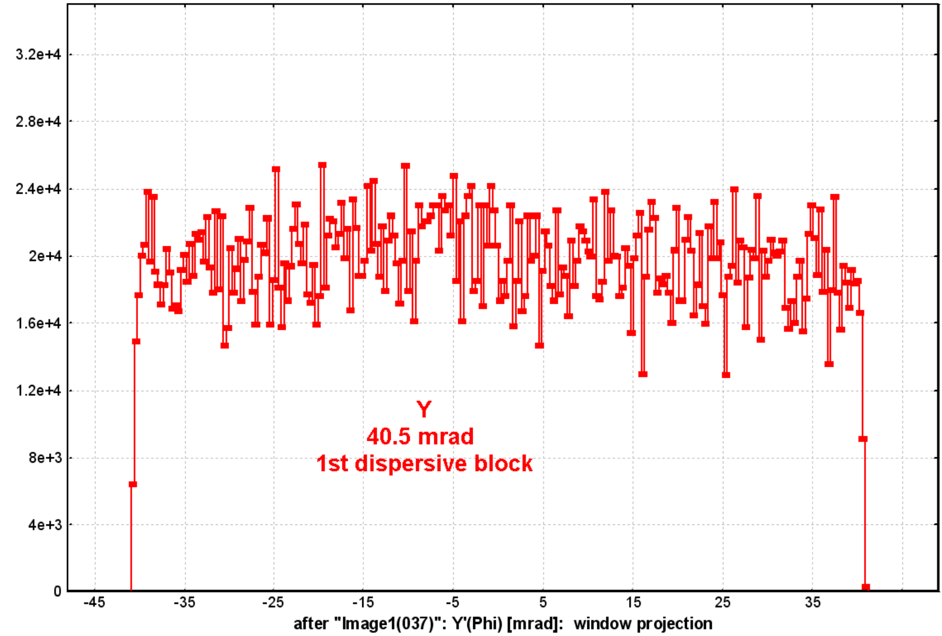


Angular Acceptance: 1st dispersive block

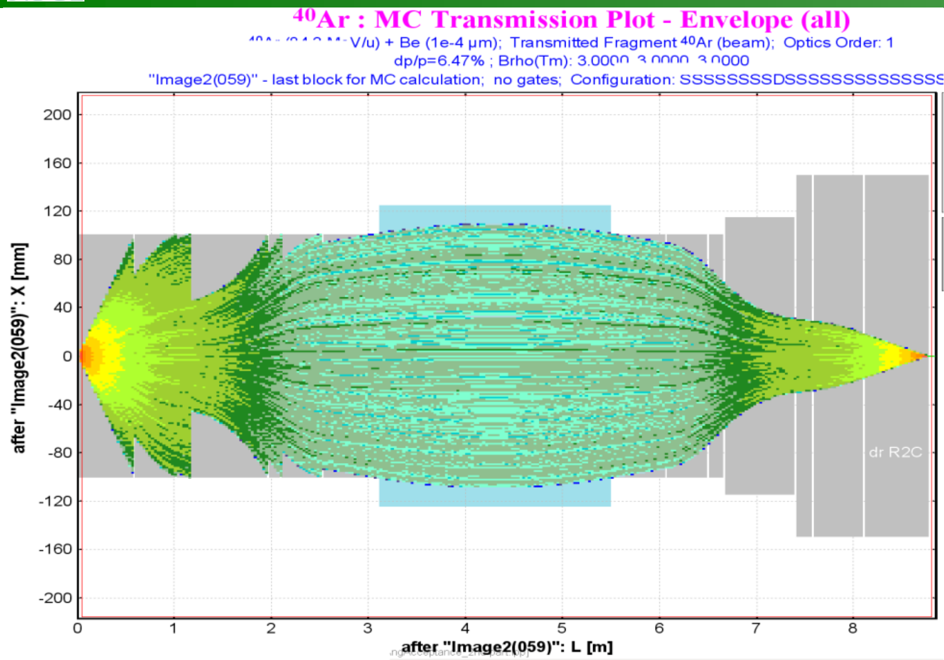


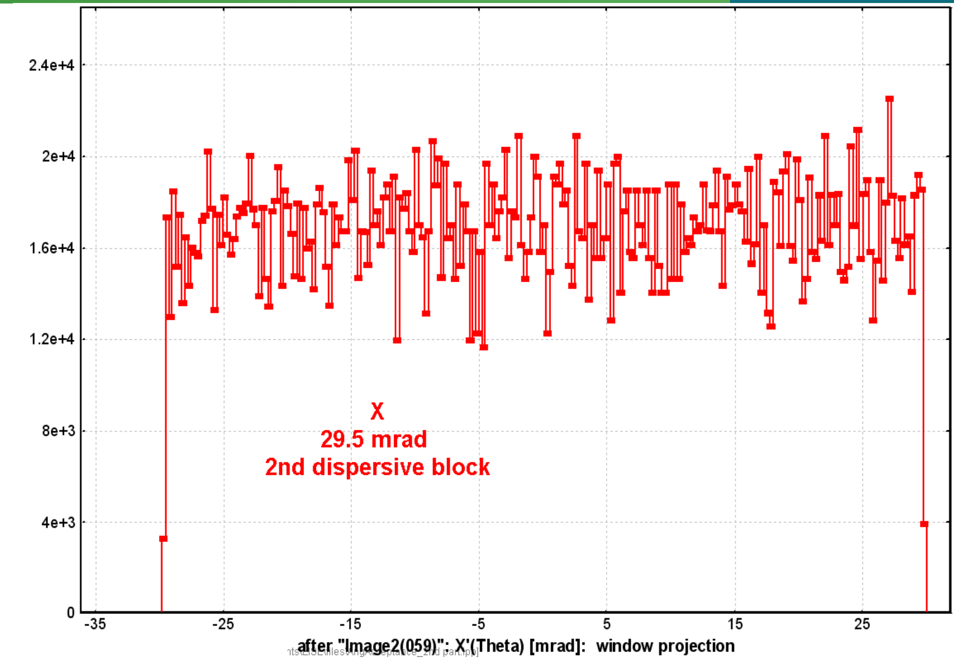


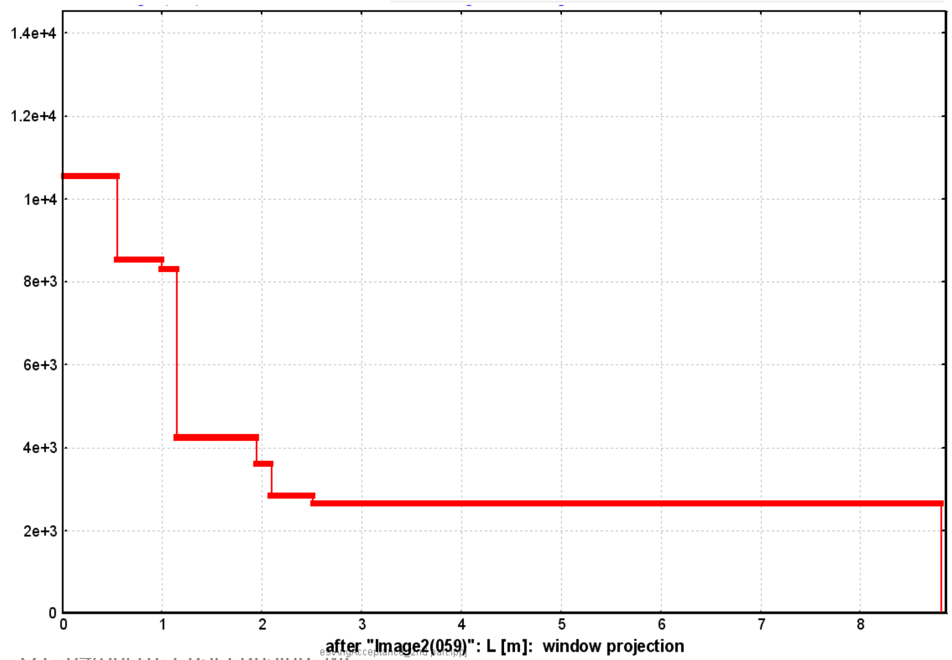


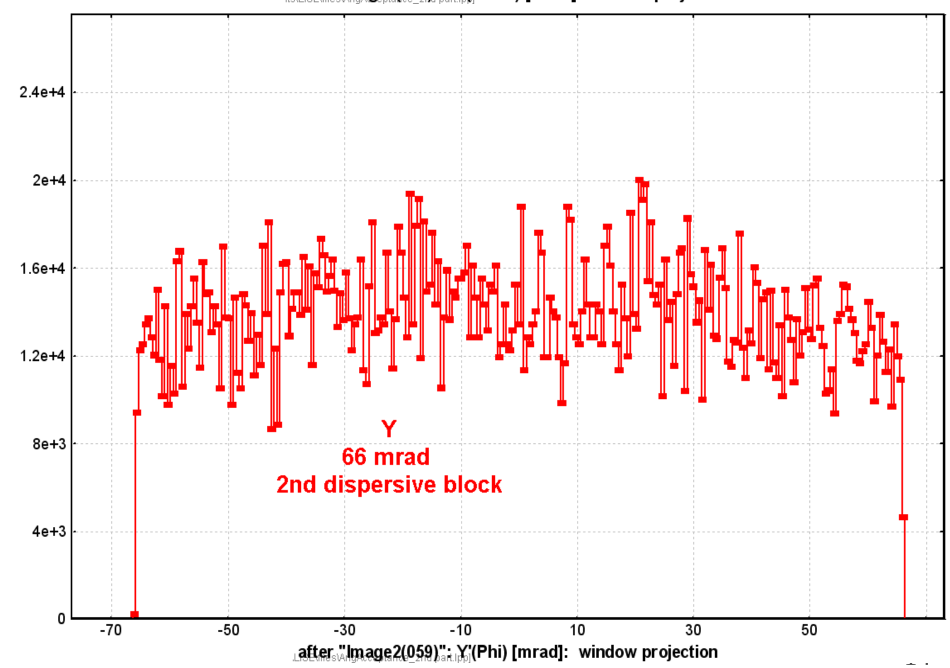


Angular Acceptance: 2nd dispersive block

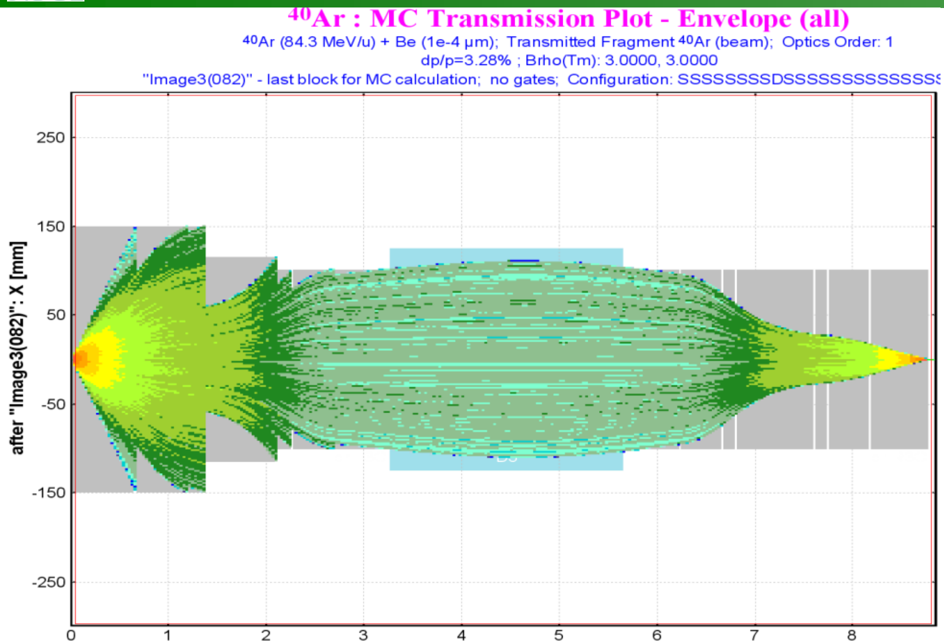


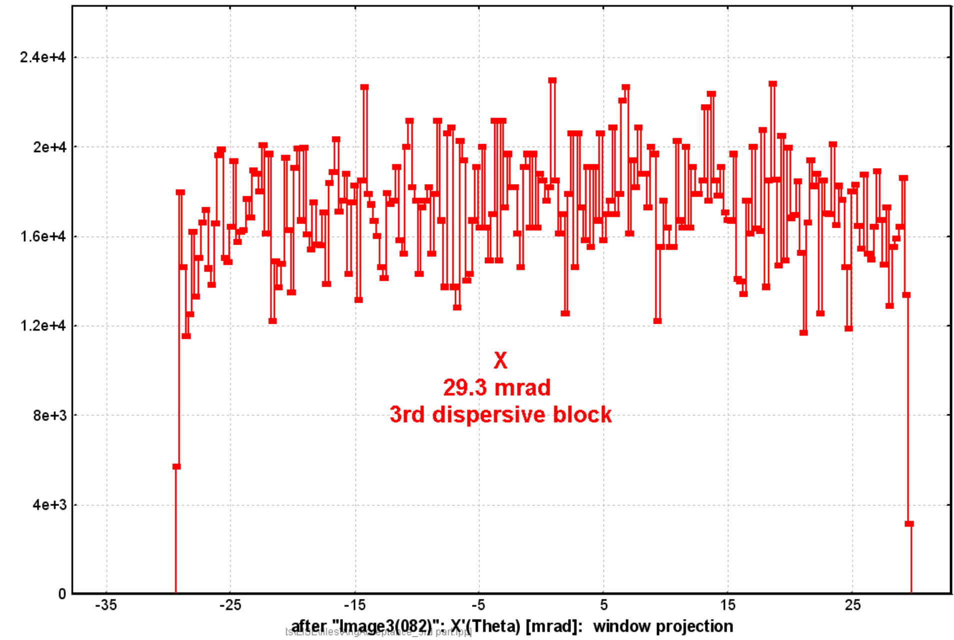


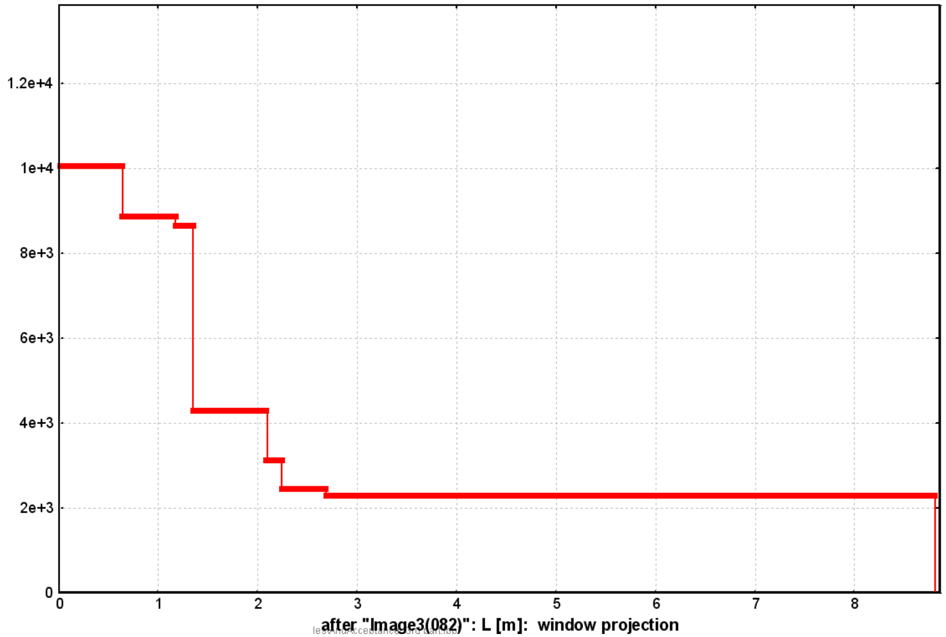


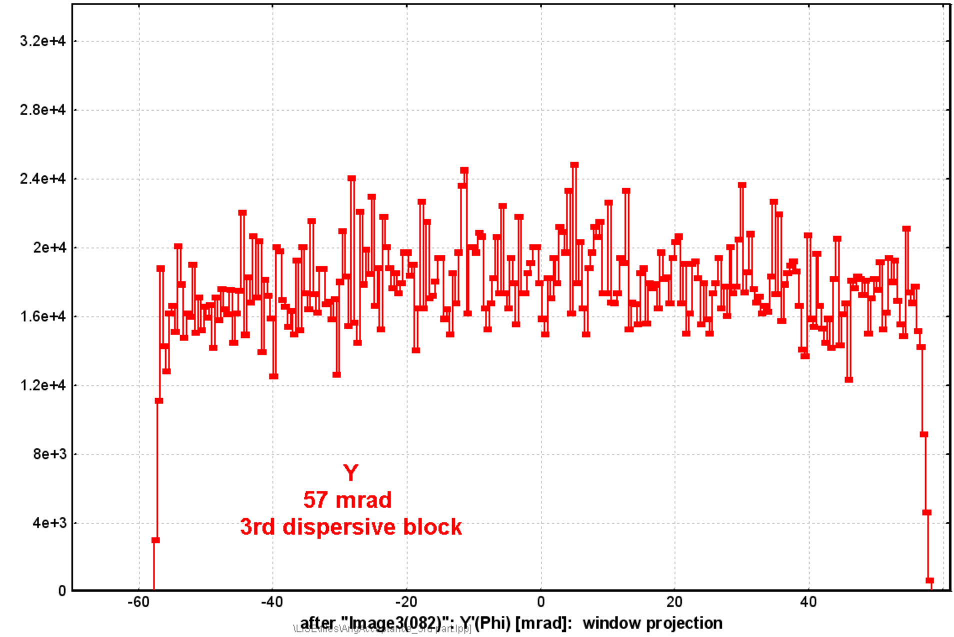


Angular Acceptance: 3rd dispersive block

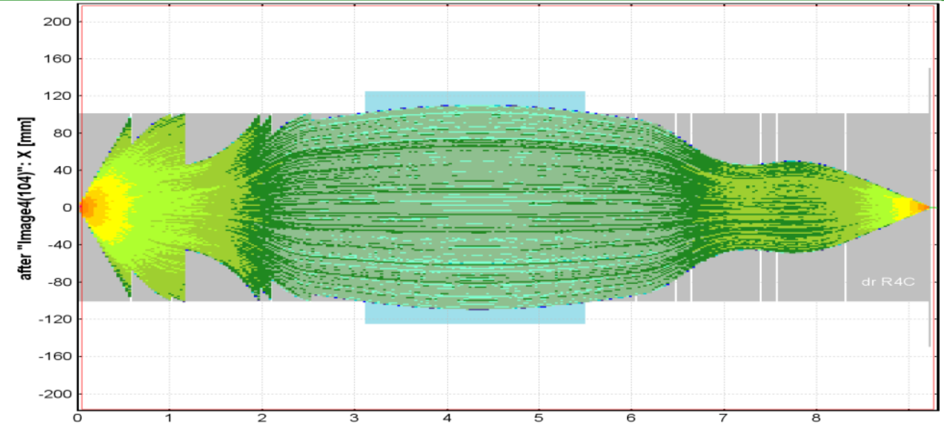


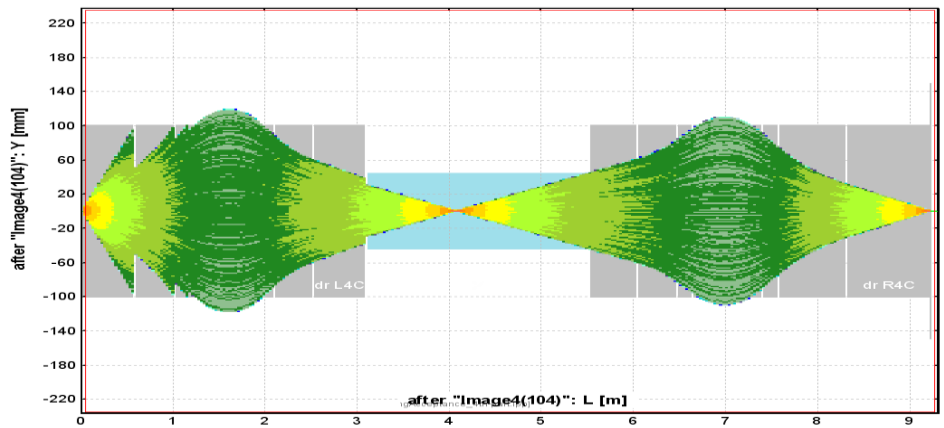


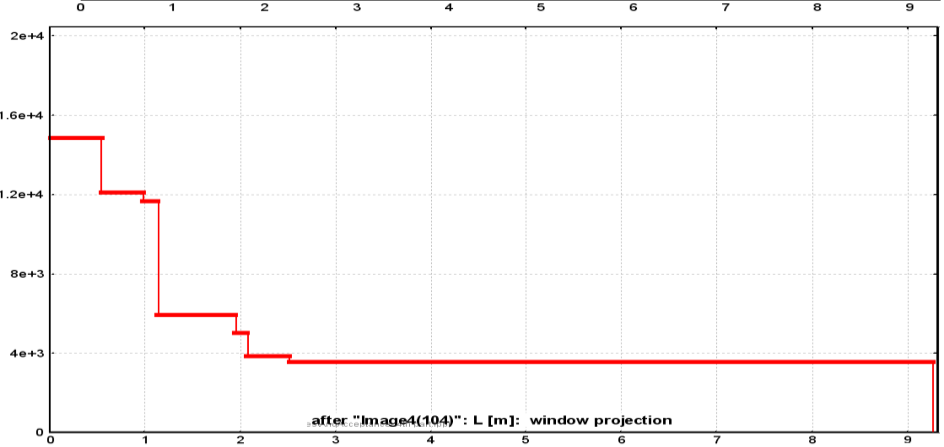


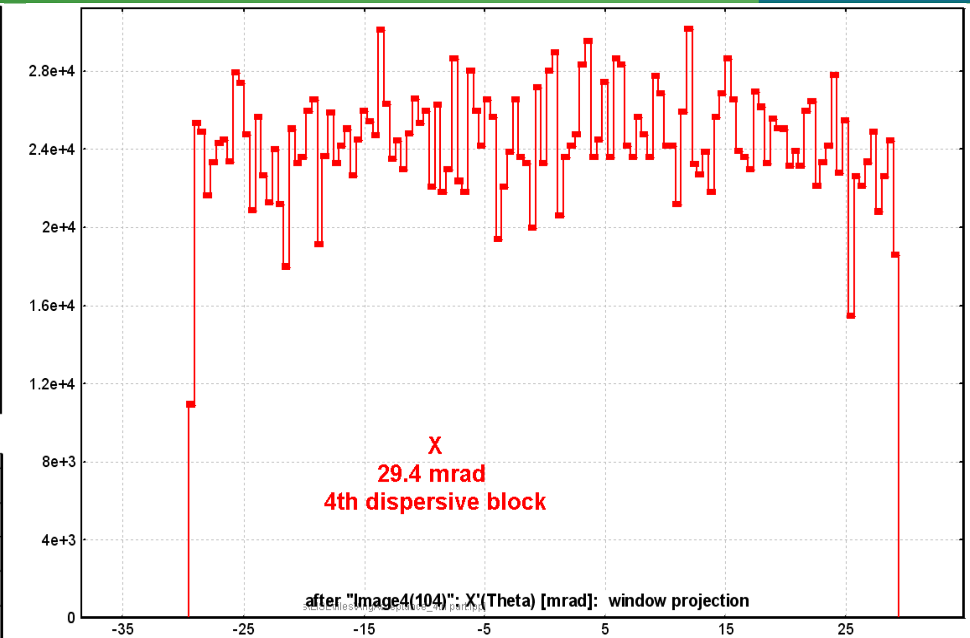


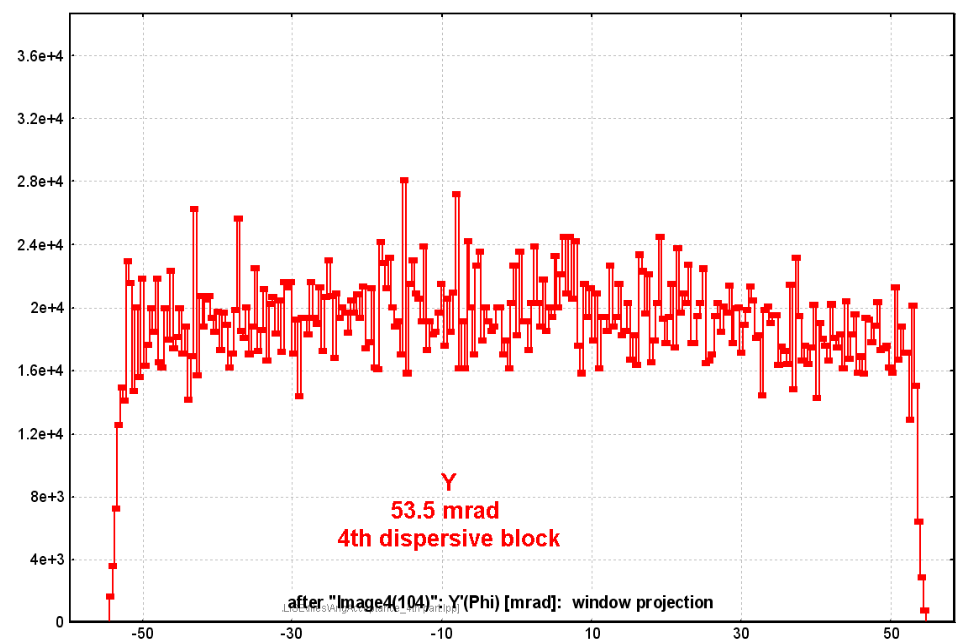
Angular Acceptance: 4th dispersive block







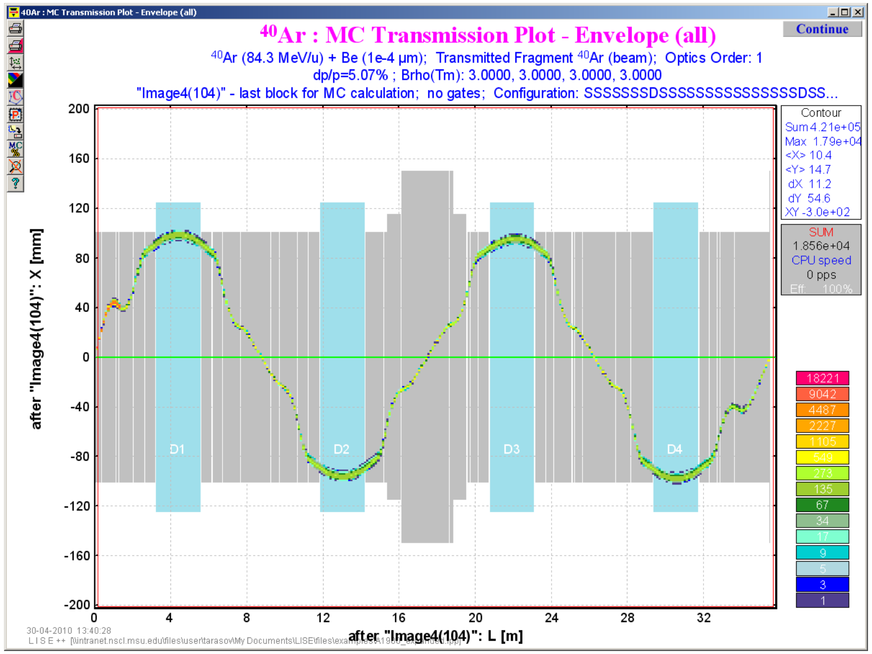


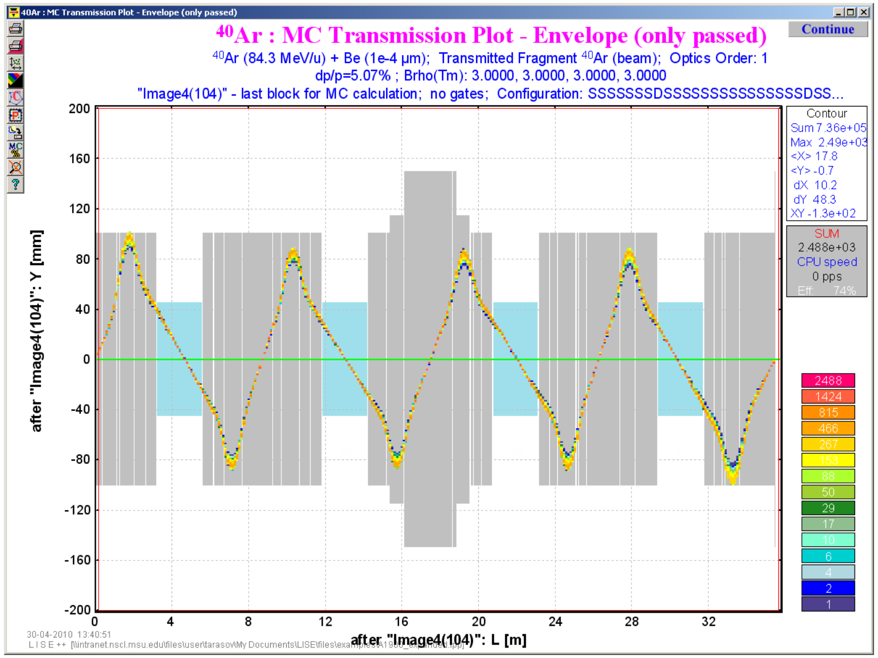


Angular Acceptance

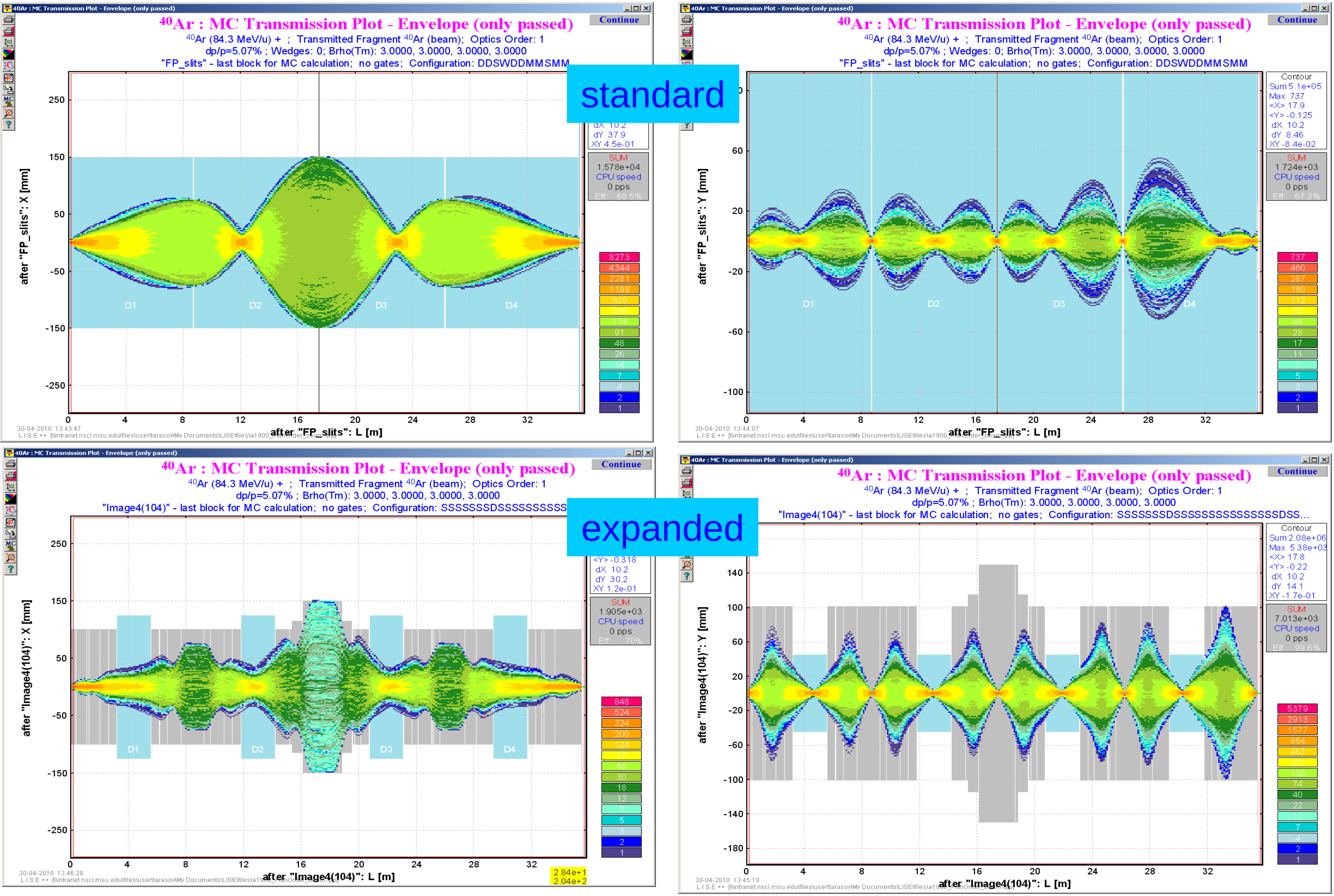
	A1900 standard		This work	
Blocks	X'	Y'	X'	Y'
1	60	40	66	40.5
2	30	60	29.5	66
3	30	55	29.3	57
4	28	50	29.4	53.5

Should be replayed with single rays.



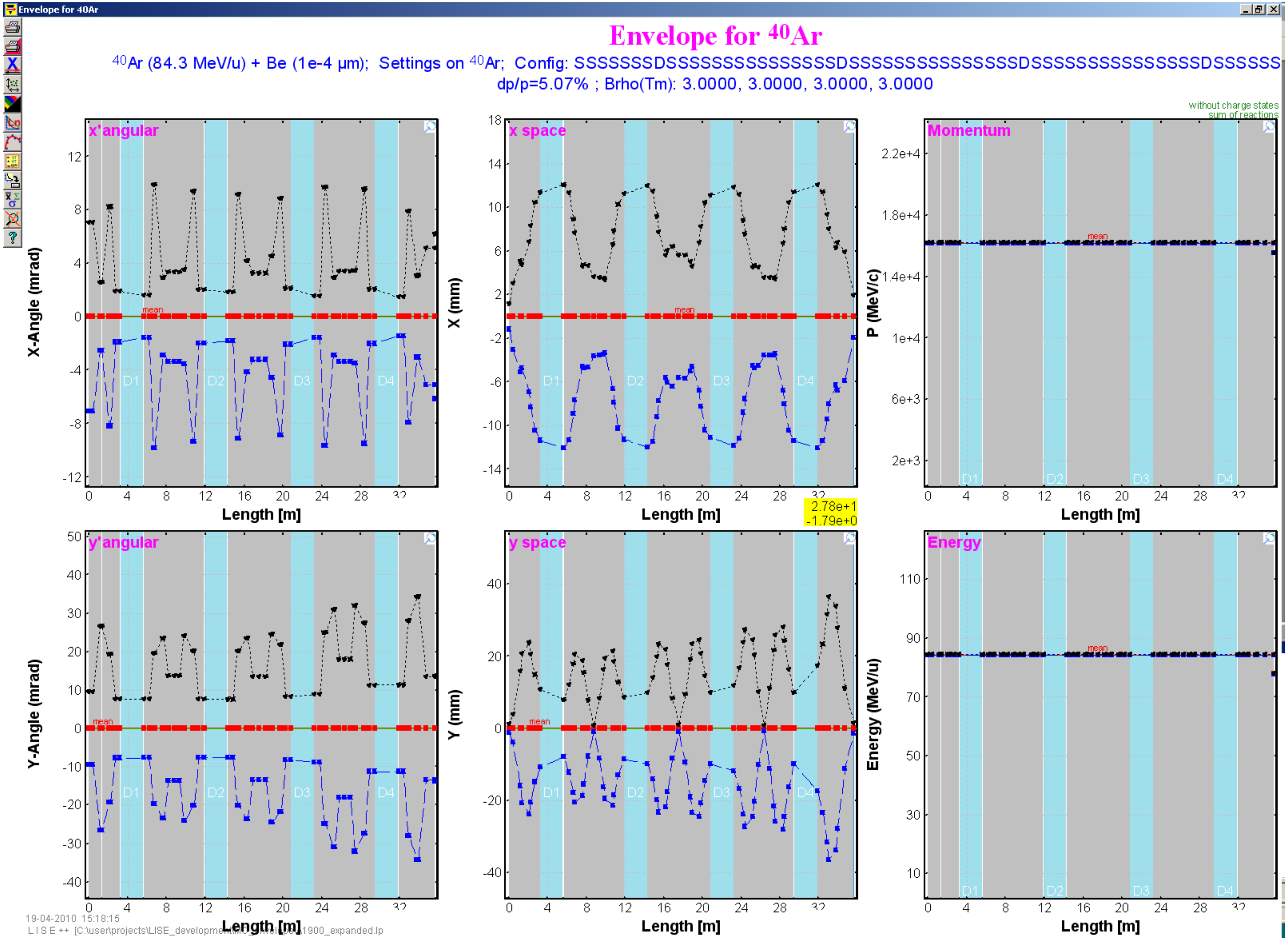


Compare standard and expanded version



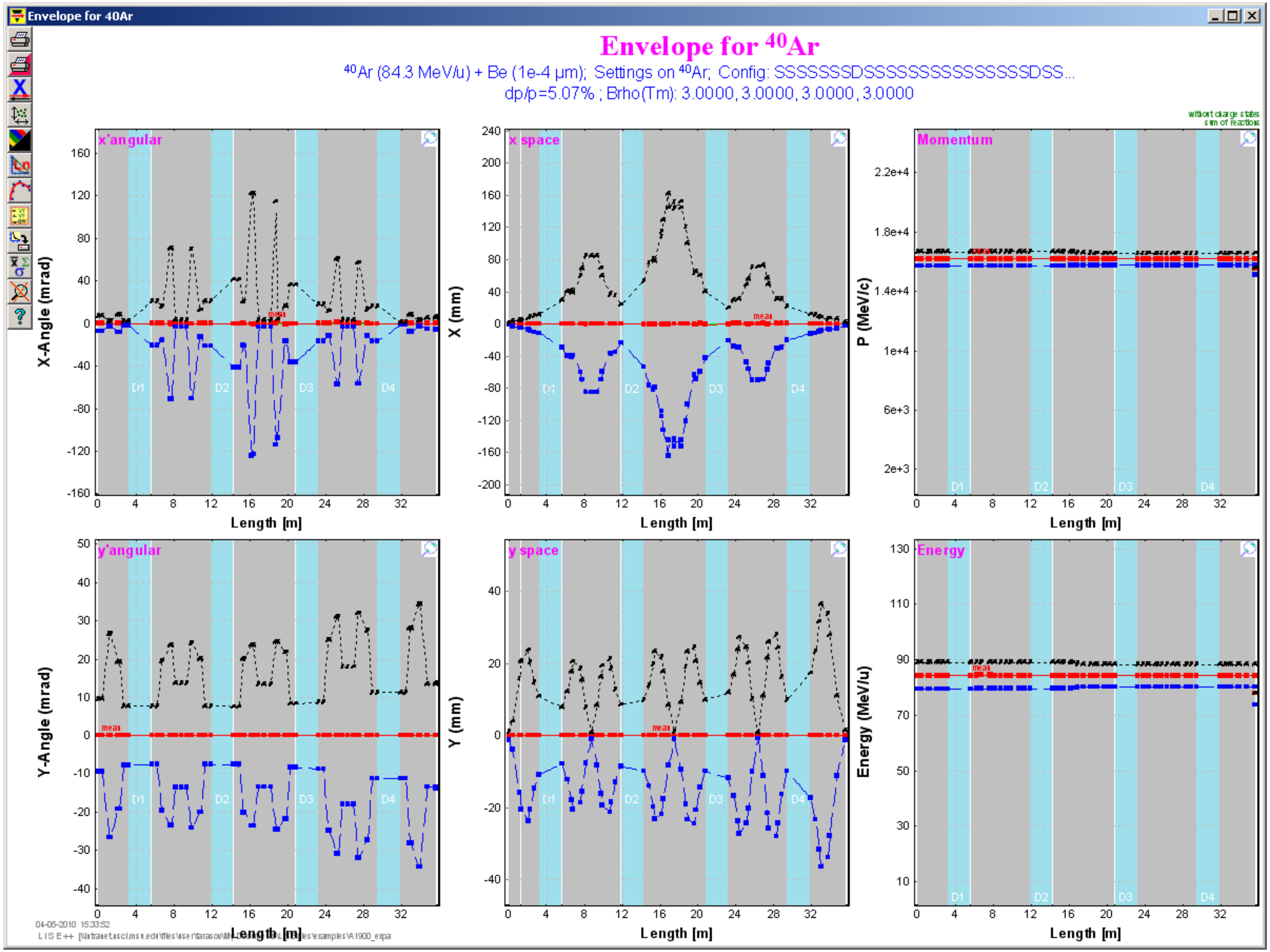
Expanded configuration vs. Distribution method

Initial Phase space: ± 6 mrad (x), ± 8 mrad (y), ± 0.07 % (dp/p)



Expanded configuration vs. Distribution method

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



Expanded configuration vs. Distribution method

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