



Utilities 1D-Plot 2D-Plot Databases Help

- CODES: Charge, Global, PACE4, etc.
- Radioactivity, decay
- Reactions utilities
- Plots : Energy loss, Ranges, Stragglng, etc.
- FRIB / NSCL / ISOL rates
- FRIB / Europe / RIKEN primary beam lists
- Set-up utilities**
  - Load ARIS experimental settings
  - ARIS Beam Dump**
  - Load A1900 experimental settings
  - Calculation of Angle on the LISE3 target
  - Catcher utility (ISOL, Fusion-Residues)
  - MSP-144 utility
  - Twinsol (solenoid) utility
  - Gas pressure optimization for gas-filled dipole
  - FRIB mass table converter to LISE++ lme file
- Range optimizer (Gas cell utility)
- Stripper foil lifetimes

ARIS Beam Dump

$^{124}\text{Xe}$  (228.0 MeV/u) + C  $\rightarrow$   $^{124}\text{Xe}$ : Energy=191.6 MeV/u, I=8.40 kW

Charge State information				
	Z-q= 0	Z-q= 1	Z-q= 2	Z-q= 3
Winger et al. [%]	77	21.8	1.19	0.0262
Leon et al. [%]	61.1	38.8	0.0965	9.35e-07
"GLOBAL" [%]	<b>81.5</b>	<b>17.5</b>	<b>0.925</b>	<b>0.00235</b>
Power [kW]	<b>6.85</b>	<b>1.47</b>	<b>0.0777</b>	<b>0.000198</b>
dBp / Bp [%]	11.64	13.74	15.93	18.20
<X <sub>2</sub> > [mm]				
σ(X <sub>2</sub> ) [mm]				
σ(Y <sub>2</sub> ) [mm]				
In Straight plane [%]				

Run settings

Bp set [Tm] **4.3000**

Number of Rays 1000

Minimum power to show charge state [kW] 1.000e-05

MC block\* BTS01c\_D1081

This is the final block used in Monte Carlo calculations to obtain charge states phase space. This location corresponds to the exit of the first preseparator dipole

Beam Dump tune

BD Center 125.000 mm

BD Width 177.800 mm

BD Bottom 36.100 mm

BD Top 213.900 mm

Execute

Run MC

Show Statistics 2D plots

Refresh Dialog 3D plot

Make Default

OK

Cancel

Help

6 Degree BD settings

Beam Dump Beam\_Dump

use previous block in MC analysis

BD Angle 6.000 deg

Longitudinal Distance 0.000 mm

Dump Transverse 8.340 mm

Longitudinal 79.350 mm

Distance "A" 93.110 mm

"B" 251.860 mm

Straight Longitudinal Downstream 172.460 mm

Upstream 172.510 mm

Straight Plane Downstream 173.410 mm

Upstream 173.460 mm

6 charge states are analyzed by the utility, only those above the threshold are shown in the dialogue

Refresh the dialog if you modify the main configuration (beam, target, optics, Brho)

# Selection Block for MC

two different choices: answer one

<b>Projectile</b>	124 Xe <sup>54+</sup>	secRea 0
	228 MeV/u	10 kW
<b>Fragment</b>	124 Xe <sup>54+.. 54+</sup>	beam
<b>T</b> Target	<sup>12</sup> C 2.1 mm	q*
<b>St</b> Stripper		
<b>d</b> BTS01a_PTS	standard : 50.2 cm	e ✓
<b>R</b> rotate_PS	Angle= +90 deg	e ✓
<b>D</b> BTS01b_D1ex	Bp=4.3000 Tm	e ✓
<b>d</b> BTS01c_D1081	standard : 61.65 cm	e ✓
<b>Sf</b> Beam_Dump	1 finger : 177.8 mm	e ✓

6 Degree BD settings

Beam Dump **BTS01b\_D1ex**

use previous block in MC analysis

BD Angle **6.000** deg

Longitudinal Distance **616.5** mm

---

MC block\* **BTS01b\_D1ex**

This is the final block used in Monte Carlo calculations to obtain charge states phase space. This location corresponds to the exit of the first preseparator dipole.

6 Degree BD settings

Beam Dump **Beam\_Dump**

use previous block in MC analysis

BD Angle **6.000** deg

Longitudinal Distance **0.000** mm

Charge State information

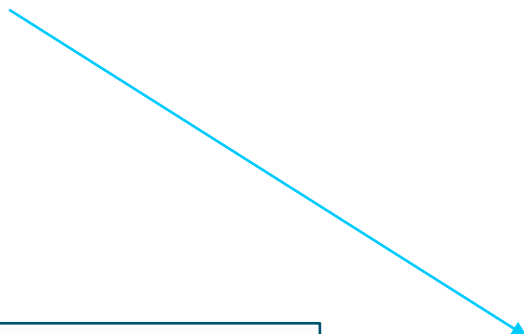
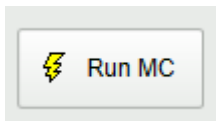
	Z-q= 0	Z-q= 1	Z-q= 2	Z-q= 3
Winger et al. [%]	77	21.8	1.19	0.0262
Leon et al. [%]	61.1	38.8	0.0965	9.35e-07
"GLOBAL" [%]	<b>81.5</b>	<b>17.5</b>	<b>0.925</b>	<b>0.00235</b>
Power [kW]	<b>6.85</b>	<b>1.47</b>	<b>0.0777</b>	<b>0.000198</b>
dBp / Bp [%]	11.64	13.74	15.93	18.20
<X <sub>2</sub> > [mm]	91.8	106.6	121.3	136.3
σ(X <sub>2</sub> ) [mm]	2.55	2.92	3.18	3.47
σ(Y <sub>2</sub> ) [mm]	10.73	11.38	11.61	12.42
In Straight plane [%]	90.9	88.5	88.3	86.0

Charge State information

	Z-q= 0	Z-q= 1	Z-q= 2	Z-q= 3
Winger et al. [%]	77	21.8	1.19	0.0262
Leon et al. [%]	61.1	38.8	0.0965	9.35e-07
"GLOBAL" [%]	<b>81.5</b>	<b>17.5</b>	<b>0.925</b>	<b>0.00235</b>
Power [kW]	<b>6.85</b>	<b>1.47</b>	<b>0.0777</b>	<b>0.000198</b>
dBp / Bp [%]	11.64	13.74	15.93	18.20
<X <sub>2</sub> > [mm]	91.7	106.4	121.2	136.4
σ(X <sub>2</sub> ) [mm]	2.52	2.78	3.14	3.44
σ(Y <sub>2</sub> ) [mm]	10.75	11.48	11.55	12.64
In Straight plane [%]	91.1	89.0	88.3	84.3

MC calculates the transmission "AFTER" the selected block, so do not use the Beam Dump block directly.

It takes a couple seconds



### Marc's Excel notations moved to C++

```

pointBD::pointBD(const pointMC& pMC)
{
    double angleRad = qDegreesToRadians(_BD.angle);

    double tanAr = qTan(angleRad);
    double tanXp = qTan(pMC.getXp()/1000.);
    double tanYp = qTan(pMC.getYp()/1000.);

    x0 = pMC.getX();
    a0 = pMC.getXp();

    l1 = (_BD.LongDist * tanAr - pMC.getY())/ (tanYp + tanAr);
    p1 = (l1*_BD.LongDist)/qCos(angleRad);

    x1 = pMC.getX() + l1 * tanXp;
    y1 = pMC.getY() + l1 * tanYp;

    x2 = pMC.getX() + _BD.LongDist * tanXp;
    y2 = pMC.getY() + _BD.LongDist * tanYp;
}
    
```

$^{124}\text{Xe}$  (228.0 MeV/u) + C  $\rightarrow$   $^{124}\text{Xe}$ : Energy=191.6 MeV/u, I=8.40 kW

Charge State information

	Z-q= 0	Z-q= 1	Z-q= 2	Z-q= 3
Winger et al. [%]	77	21.8	1.19	0.0262
Leon et al. [%]	61.1	38.8	0.0965	9.35e-07
"GLOBAL" [%]	81.5	17.5	0.925	0.00235
Power [kW]	6.85	1.47	0.0777	0.000198
dBp / Bp [%]	11.64	13.74	15.93	18.20
<X <sub>2</sub> > [mm]	91.6	106.6	121.3	136.2
$\sigma$ (X <sub>2</sub> ) [mm]	2.41	2.88	3.10	3.45
$\sigma$ (Y <sub>2</sub> ) [mm]	10.53	10.92	11.74	12.68
In Straight plane [%]	91.9	89.3	86.9	85.9

6 Degree BD settings

Beam Dump: BTS01b\_D1ex

use previous block in MC analysis

BD Angle: 6.000 deg

Longitudinal Distance: 616.5 mm

Dump: Transverse 8.340 mm

Longitudinal 79.350 mm

Distance: "A" 93.110 mm

"B" 251.860 mm

Straight Longitudinal: Downstream 172.460 mm

Upstream 172.510 mm

Straight Plane: Downstream 173.410 mm

Upstream 173.460 mm

Run settings

Bp set [Tm]: 4.3000

Number of Rays: 1000

Minimum power to show charge state [kW]: 1.000e-05

MC block\*: BTS01b\_D1ex

This is the final block used in Monte Carlo calculations to obtain charge states phase space. This location corresponds to the exit of the first preseparator dipole

Beam Dump tune

BD Center: 125.000 mm

BD Width: 177.800 mm

BD Bottom: 36.100 mm

BD Top: 213.900 mm

Execute

Run MC

Show Statistics

2D plots

Refresh Dialog

3D plot

Make Default

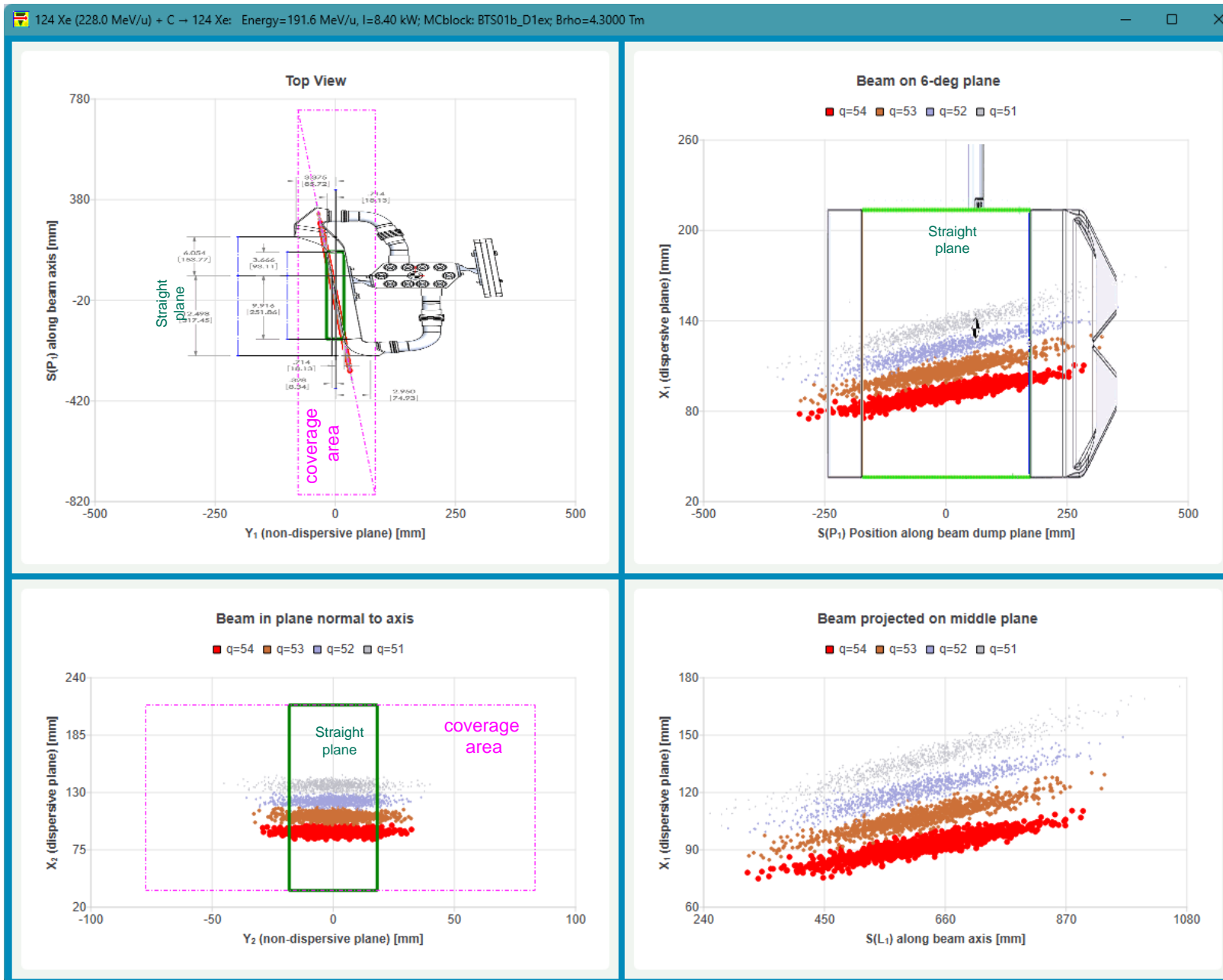
OK

Cancel

Help

Enabled (See the next slide)

Segmented  
LISE file



## Extended LISE file 5<sup>th</sup> order

6 Degree BD settings

Beam Dump: toBDaxis

use previous block in MC analysis

BD Angle: 6.000 deg

Longitudinal Distance: 0 mm

---

Charge State information

	Z-q=0	Z-q=1	Z-q=2	Z-q=3
Winger et al. [%]	77	21.8	1.19	0.0262
Leon et al. [%]	61.1	38.8	0.0965	9.35e-07
"GLOBAL" [%]	81.5	17.5	0.925	0.00235
Power [kW]	6.85	1.47	0.0777	0.000198
dBp / Bp [%]	11.64	13.74	15.93	18.20
<X <sub>2</sub> > [mm]	91.6	106.4	121.3	136.1
σ(X <sub>2</sub> ) [mm]	2.88	3.20	3.64	3.81
σ(Y <sub>2</sub> ) [mm]	10.28	10.58	11.31	11.93
In Straight plane [%]	91.5	92.2	89.4	87.2

---

Run settings

Bp set [Tm]: 4.3000

Number of Rays: 1000

Minimum power to show charge state [kW]: 1.000e-05

MC block\*: toBDaxis

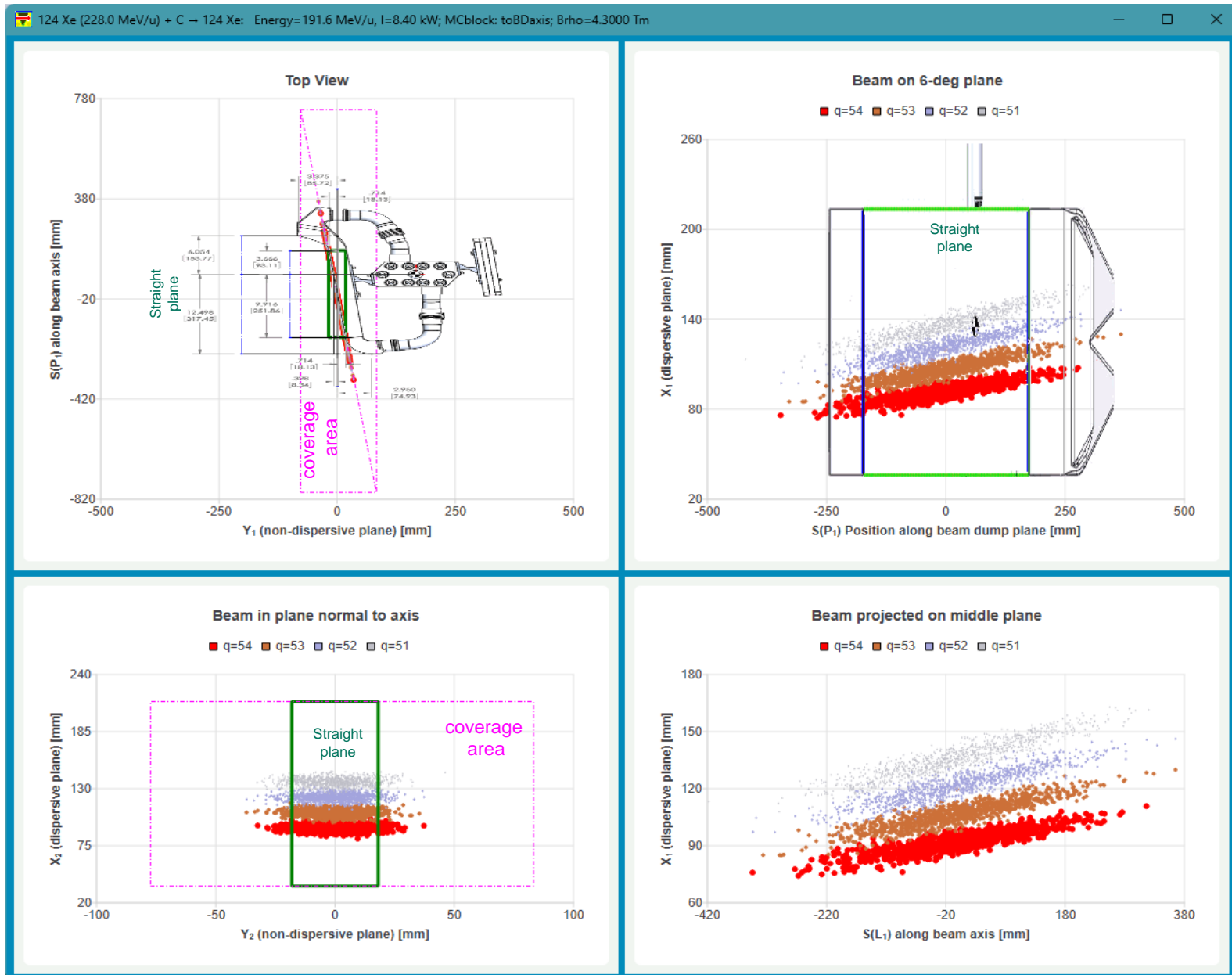
This is the final block used in Monte Carlo calculations to obtain charge states phase space. This location corresponds to the exit of the first preseparator dipole.

Beam Dump:

- BD Center
- BD Width
- BD Bottom
- BD Top

T	Target	<sup>12</sup> C 2.1 mm
Str	Stripper	
d	FRNT-SHLD	standard : 5 cm
Q	WIQ2	QUAD : 1.05 m
d	L1030	standard : 5 cm
Q	WIQ3	QUAD : 1.05 m
d	L1040	standard : 15 cm
d	Ltv1	standard : 30 cm
S	TV-SHLD	slits
d	Ltv2	standard : 30 cm
d	L1051	standard : 65 cm
D	FSD1_SCD1	Bp=4.3000 Tm
d	toBDaxis	standard : 62.34 cm
d	toIMG1	standard : 8.96 cm
S	slit_IMG1	slits

-200 H +200 -200 V +200





## Segmented

## Extended

Beam Dump MC statistics

Save As Print PrintView Consolas

$^{124}\text{Xe}$  (228.0 MeV/u) + C  $\rightarrow$   $^{124}\text{Xe}$ : Energy=191.6 MeV/u, I=8.40 kW  
 MC block : **BTS01b\_D1ex**; Bp = **4.3000** Tm; MC high order = 5

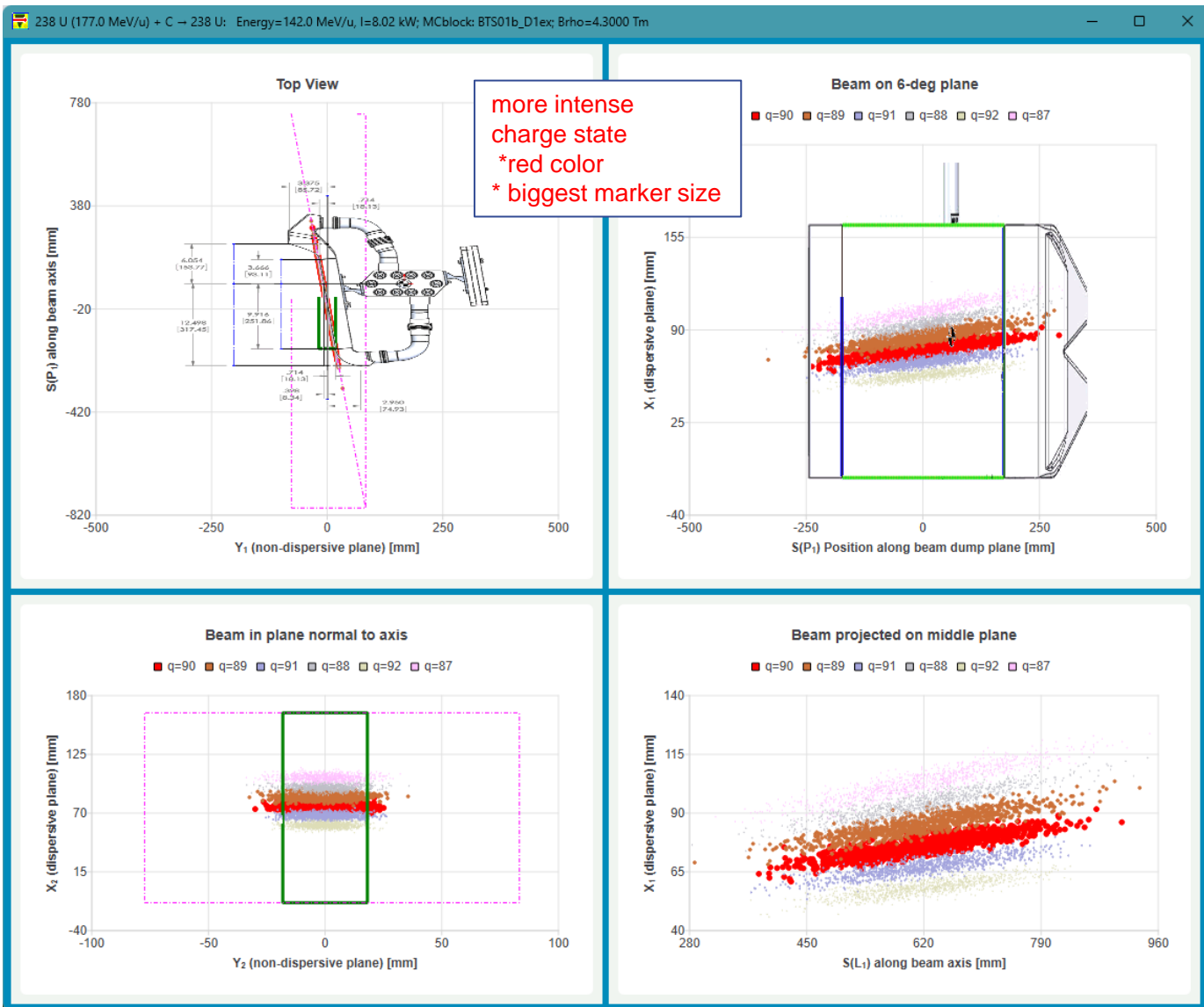
q	54	53	52	51
Power [kW]	6.85e+00	1.47e+00	7.77e-02	1.98e-04
<A <sub>0</sub> >	54.07	62.83	71.42	80.14
<L <sub>1</sub> >	616.31	614.98	614.28	612.52
<P <sub>1</sub> >	-0.19	-1.53	-2.23	-4.01
<X <sub>0</sub> >	58.43	67.68	77.30	86.59
<X <sub>1</sub> >	91.78	106.36	121.24	135.77
<X <sub>2</sub> >	91.79	106.46	121.40	136.10
<Y <sub>1</sub> >	0.02	0.16	0.23	0.42
<Y <sub>2</sub> >	0.13	0.31	0.40	0.63
$\sigma(\text{A}_0)$	1.78	1.70	1.60	1.61
$\sigma(\text{L}_1)$	98.67	108.70	111.46	123.86
$\sigma(\text{P}_1)$	99.21	109.30	112.07	124.54
$\sigma(\text{X}_0)$	3.38	3.67	3.87	4.19
$\sigma(\text{X}_1)$	5.95	7.32	8.64	10.55
$\sigma(\text{X}_2)$	2.57	2.87	3.11	3.39
$\sigma(\text{Y}_1)$	10.37	11.42	11.71	13.02
$\sigma(\text{Y}_2)$	10.37	11.45	11.71	13.03

$^{124}\text{Xe}$  (228.0 MeV/u) + C  $\rightarrow$   $^{124}\text{Xe}$ : Energy=191.6 MeV/u, I=8.40 kW  
 MC block : **toBDaxis**; Bp = **4.3000** Tm; MC high order = 5

q	54	53	52	51
Power [kW]	6.85e+00	1.47e+00	7.77e-02	1.98e-04
<A <sub>0</sub> >	53.91	62.50	71.03	79.77
<L <sub>1</sub> >	-2.82	0.31	3.28	-3.41
<P <sub>1</sub> >	-2.84	0.31	3.30	-3.43
<X <sub>0</sub> >	91.60	106.43	121.28	136.10
<X <sub>1</sub> >	91.45	106.45	121.52	135.83
<X <sub>2</sub> >	91.60	106.43	121.28	136.10
<Y <sub>1</sub> >	0.30	-0.03	-0.35	0.36
<Y <sub>2</sub> >	0.41	0.09	-0.19	0.53
$\sigma(\text{A}_0)$	1.84	1.76	1.71	1.68
$\sigma(\text{L}_1)$	97.68	100.68	107.84	113.44
$\sigma(\text{P}_1)$	98.22	101.23	108.44	114.07
$\sigma(\text{X}_0)$	2.88	3.20	3.64	3.81
$\sigma(\text{X}_1)$	5.92	7.11	8.39	9.78
$\sigma(\text{X}_2)$	2.88	3.20	3.64	3.81
$\sigma(\text{Y}_1)$	10.27	10.58	11.33	11.92
$\sigma(\text{Y}_2)$	10.28	10.58	11.31	11.93

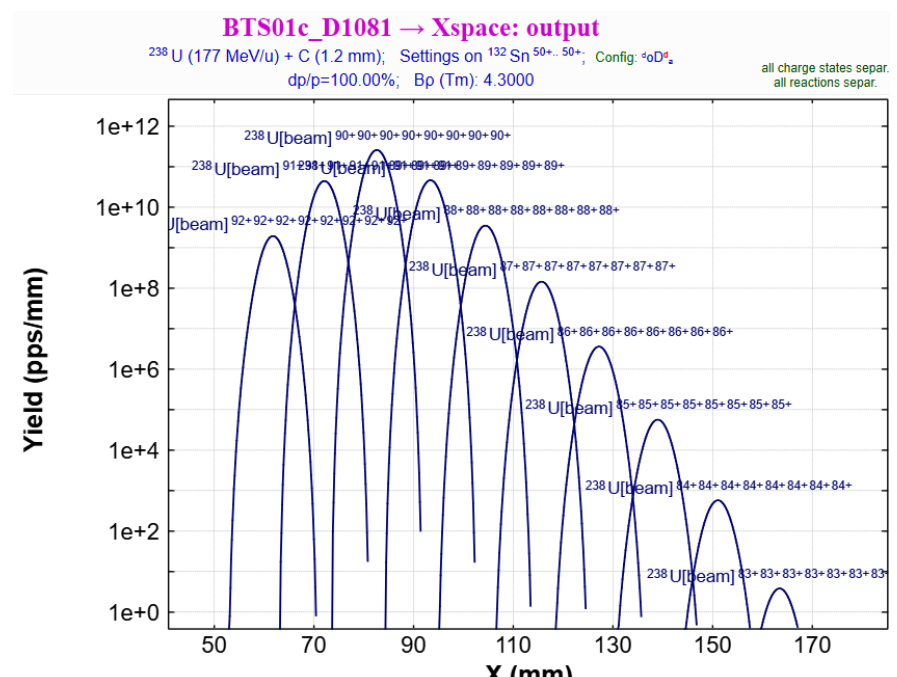
cov(X <sub>0</sub> ,A <sub>0</sub> )	-4.89	-5.11	-5.08	-5.64
corr(X <sub>0</sub> ,A <sub>0</sub> )	-0.81	-0.82	-0.82	-0.84
slope(X <sub>0</sub> ,A <sub>0</sub> )	-0.43	-0.38	-0.34	-0.32
cov(P <sub>1</sub> ,X <sub>1</sub> )	532.76	736.00	903.89	1245.21
corr(P <sub>1</sub> ,X <sub>1</sub> )	0.90	0.92	0.93	0.95
slope(P <sub>1</sub> ,X <sub>1</sub> )	0.05	0.06	0.07	0.08

# 2D plots U-beam, 6 charge states

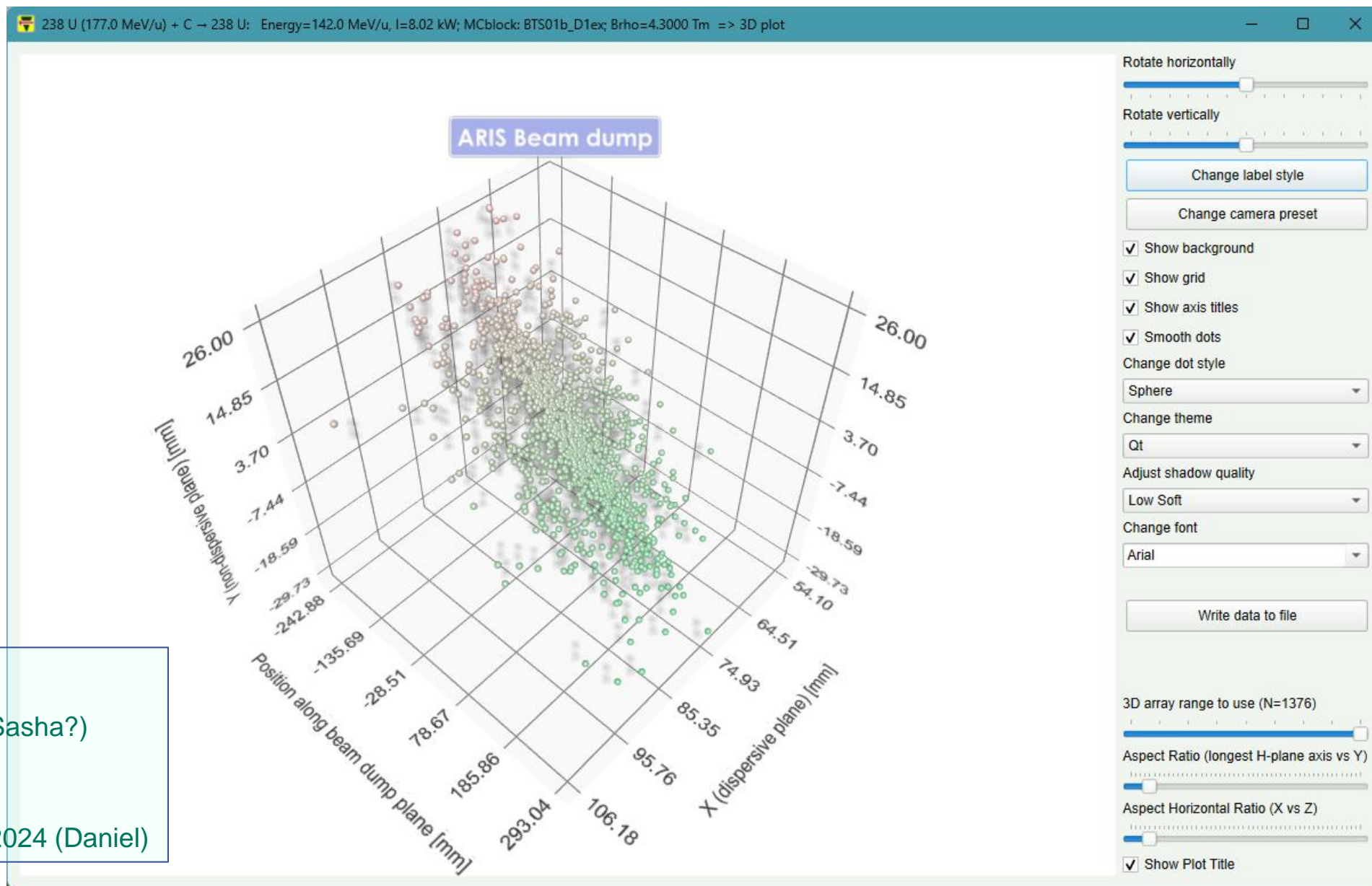


Charge State information

	Z-q= 0	Z-q= 1	Z-q= 2	Z-q= 3	Z-q= 4	Z-q= 5
Winger et al. [%]	0.00101	3.17	49.2	41.8	5.63	0.213
Leon et al. [%]	2.47	15.9	37.6	32.5	10.3	1.19
"GLOBAL" [%]	0.537	12.4	72.8	13.2	1.01	0.0423
Power [kW]	0.0431	0.994	5.84	1.06	0.0812	0.00339
dBp / Bp [%]	7.06	8.24	9.44	10.67	11.93	13.21
<X <sub>2</sub> > [mm]	58.0	66.9	75.8	85.0	93.7	102.8
σ(X <sub>2</sub> ) [mm]	2.14	2.24	2.31	2.51	2.64	2.78
σ(Y <sub>2</sub> ) [mm]	8.46	8.95	9.31	9.93	10.11	10.73
In Straight plane [%]	96.7	95.9	95.0	93.3	92.6	90.5







## Next steps

- 3D objects implementation (Sasha?)
- OpenGL (Sasha?)
- Beam Dump poster on DNP2024 (Daniel)

## Option file (\*.lopt)

```
[BeamDump]
distTransverse=8.34
LongDist=616.5
distA=93.11
distB=251.86
Width=177.8
Center=75
angle=6
minPower=1e-05
Nrays=1000
blockName=BTS01b_D1ex
usePrevious=false
```

## LISE file (\*.lpp)

```
[finger]
Diffuseness = 0.01
Suppression = 1e+12
BeamDumpBlock = BTS01b_D1ex
BD_LongDistance = 616.5
BD_usePrevious = 0
```