Beam Diagnosis System

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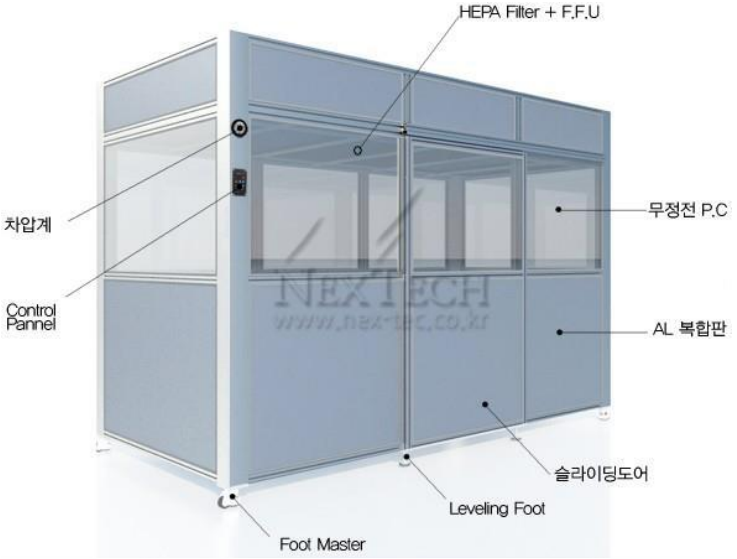
2020/04/16 LAMPS Collaboration Meeting

Current Status

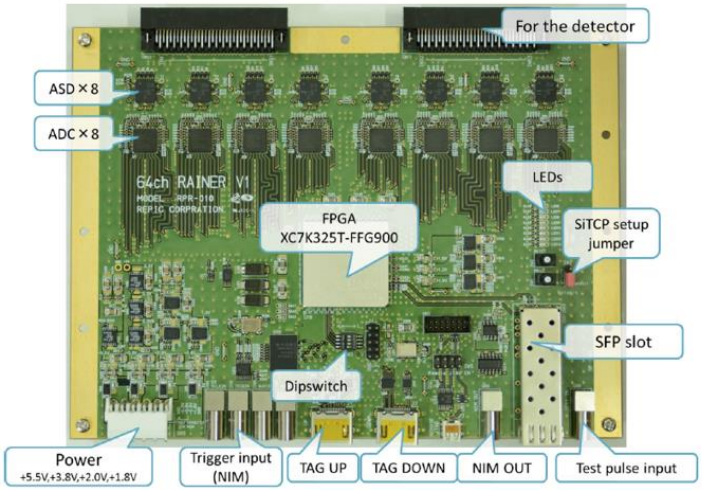
- Moving BDC production facility to CNU
  - Installation of clean room : Hard type 1500 mm x 1500 mm
    - Cleanliness class 1000 same as KRISS requirement
    - Price : 5556000 won
    - Plan : next week (delayed to 5/19)
  - Purchase of Equipment to construct

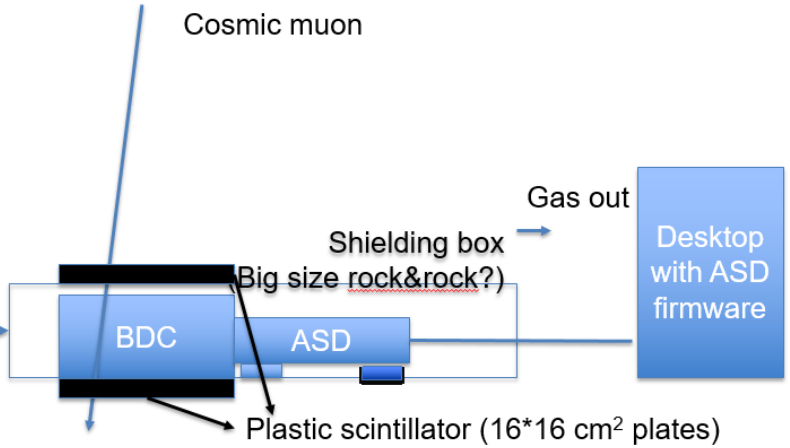
Product	Serial	Price	Remarks
LV PowerSupply	GPD-3303S	608217	Eleparts (719000)
ASD LV connector	S6P-VH(LF)(SN)	25 pieces*910=22750	eleparts
18 AWG 실리콘 와이어 6색 SET (30m:5m*6)	EPXMUUDH	24100	eleparts
멀티미터	FLUKE-17B+	140000	eleparts
인두기			
무연인두기+인두팁	Hakko FX-951	304000	eleparts
무연실납(0.3mm, 약233m)	HS-341	49000	eleparts
초음파 클리너		~1000000 - 1500000	
Ion Blower		352000	
플럭스 펜		9000	
도르래		9400	
플라스틱 고정대 (or 볼트)		~ 10000	
전자저울	0.01 g 정밀도의 저울	220000	
기판을 고정시키는 판, 와이어를 걸어두는 고리		KRISS에 의뢰 필요 (CNC 선반으로 직접가공)	
절연테이프 등 추가		<100000	약 3550000원 예상 크린부스 시공비까지 8995000원



Summary & Plan

- Moving the place to construct BDC to CNU will be done (middle of May)
- Working on designing the frame of BDC (middle of May)
- Will test ASD board as soon as possible to have power (middle of May)
- Will setup cosmic muon test
  (early June)





- Power input connector : S6P-VH
- 6 wires should be connected (GND, +5.5V, +3.8V, +2.0V, +1.8V, GND), Maximum current : 5A
- 2 * 2 channel power supply are needed
  - 1 from KRISS, 1 will be ordered

Thank You Very Much
for your attention !

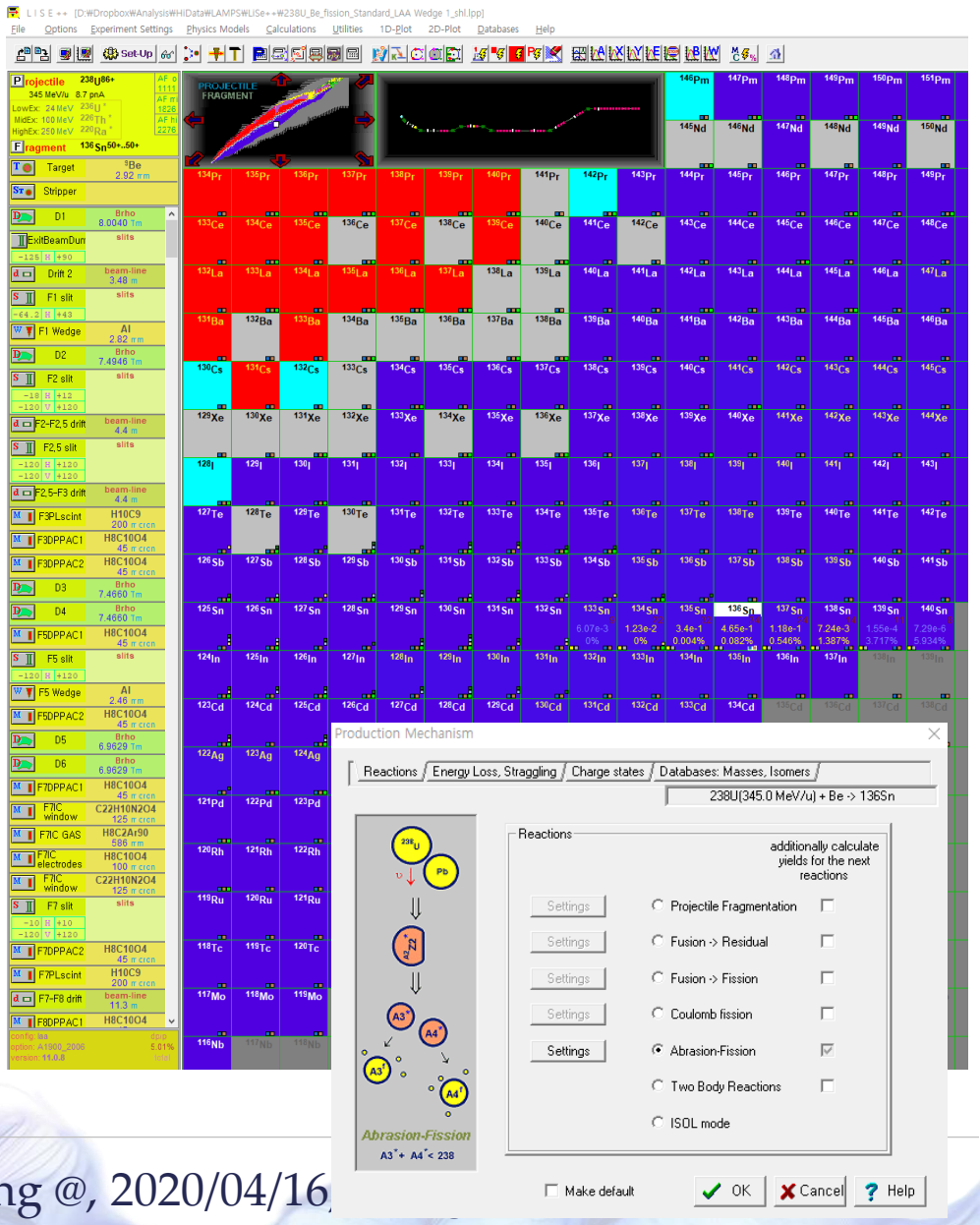
Back Up

Get Yield of ^{136}Sn by LiSe++

- In order to verify if our understanding would be correct or not, we reproduced yield of ^{136}Sn by LiSe++
- BigRIPS results : Y. Shimizu et al., JPSJ 87 (2018) 014203

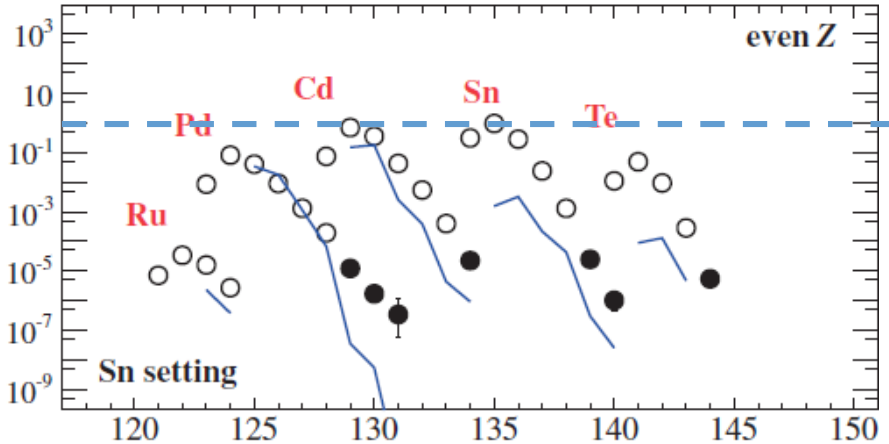
	Sn setting
Primary beam	$^{238}U^{86+}$
	345 MeV/nucleon
$B\rho$[a)]	8.004 Tm
Central particle[b)]	$^{136}Sn^{50+}$
Production target	Be 2.92 mm
Degrader at F1	Al 2.82 mm
Degrader at F5	Al 2.46 mm
Exit beam dump	+90.0/−125.0 mm
F1 slit	+43.0/−64.2 mm
F2 slit	+12.0/−18.0 mm
F7 slit	+10.0/−10.0 mm
Average beam intensity[c)]	8.70 pnA
Total dose	1.95×10^{16} particles
Average live time	98.2%
Average trigger rate	55.1 particles/s
Irradiation time	99.6 h

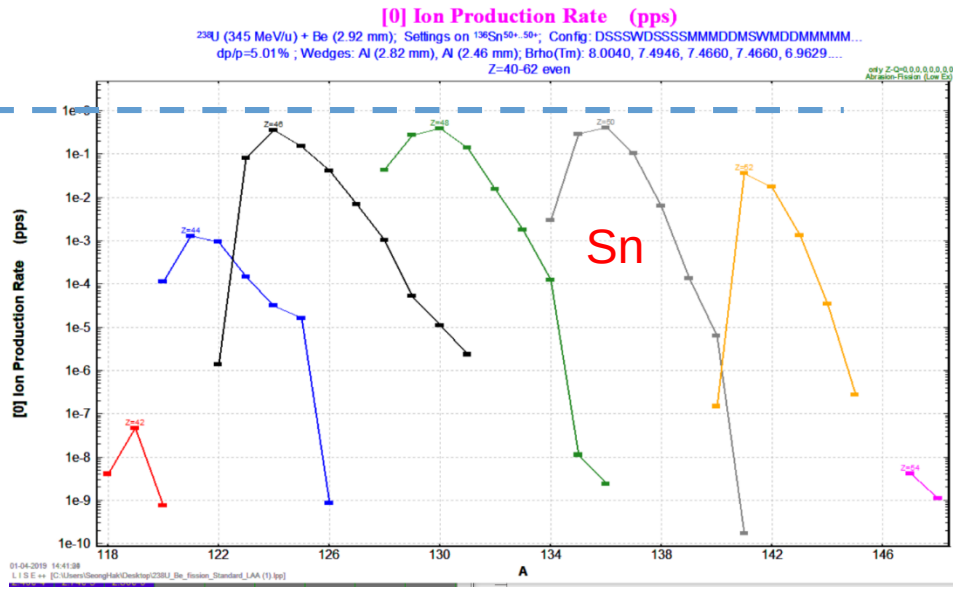
a) Values from the magnetic fields of the first dipole ma
b) The $B\rho$ setting after F1 is tuned for the listed ions.
c) 1 pnA (particle nA) = 6.24×10^9 particles/s.



Get Yield of ^{136}Sn by LiSe++

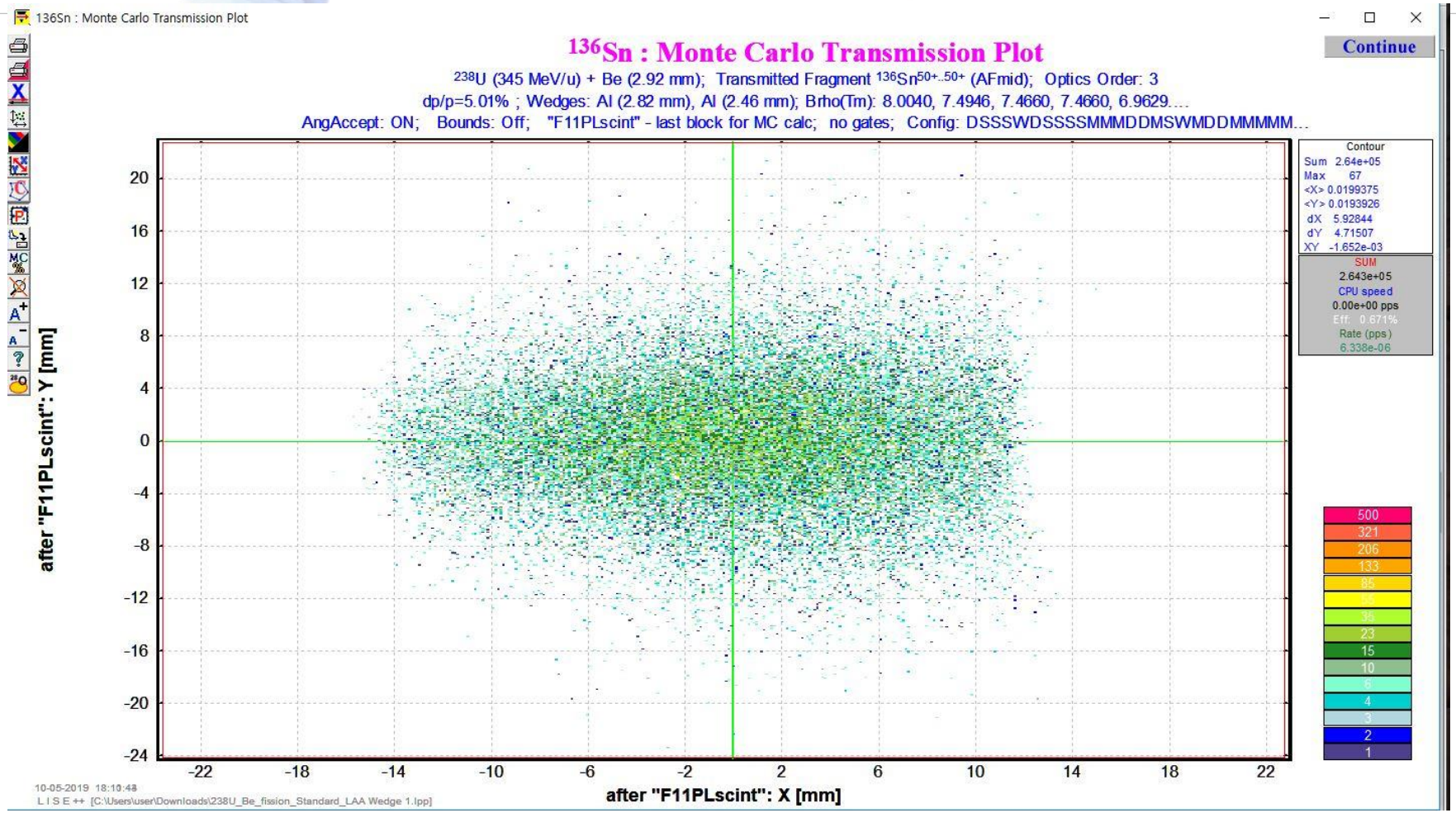
- Results





Not same but similar order of magnitude for the yield of ^{136}Sn

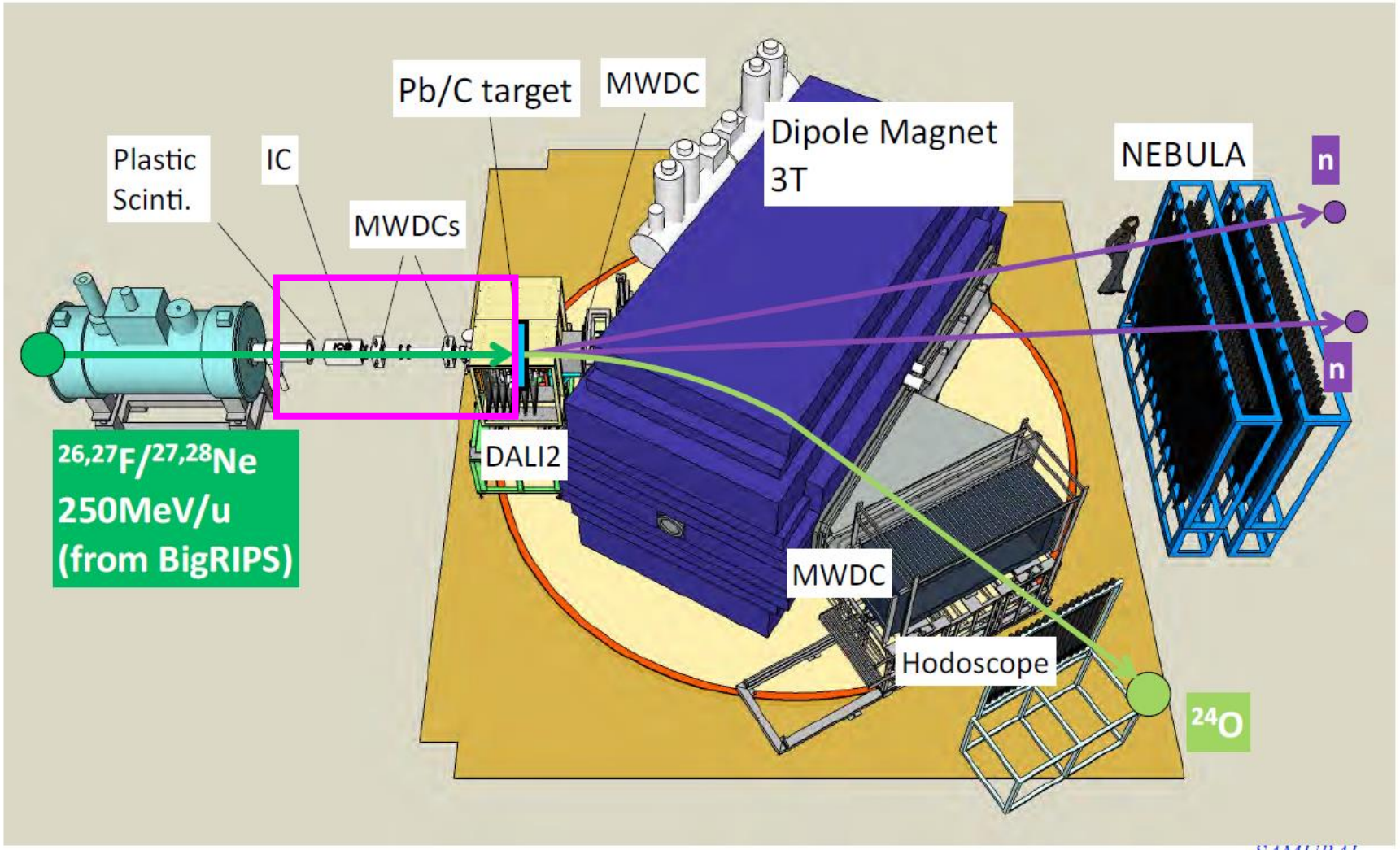
Beam Size Study



Final observed beam size : x (-1.4 ~ 1.2 cm) and y (-1.2 ~ 1.2 cm)

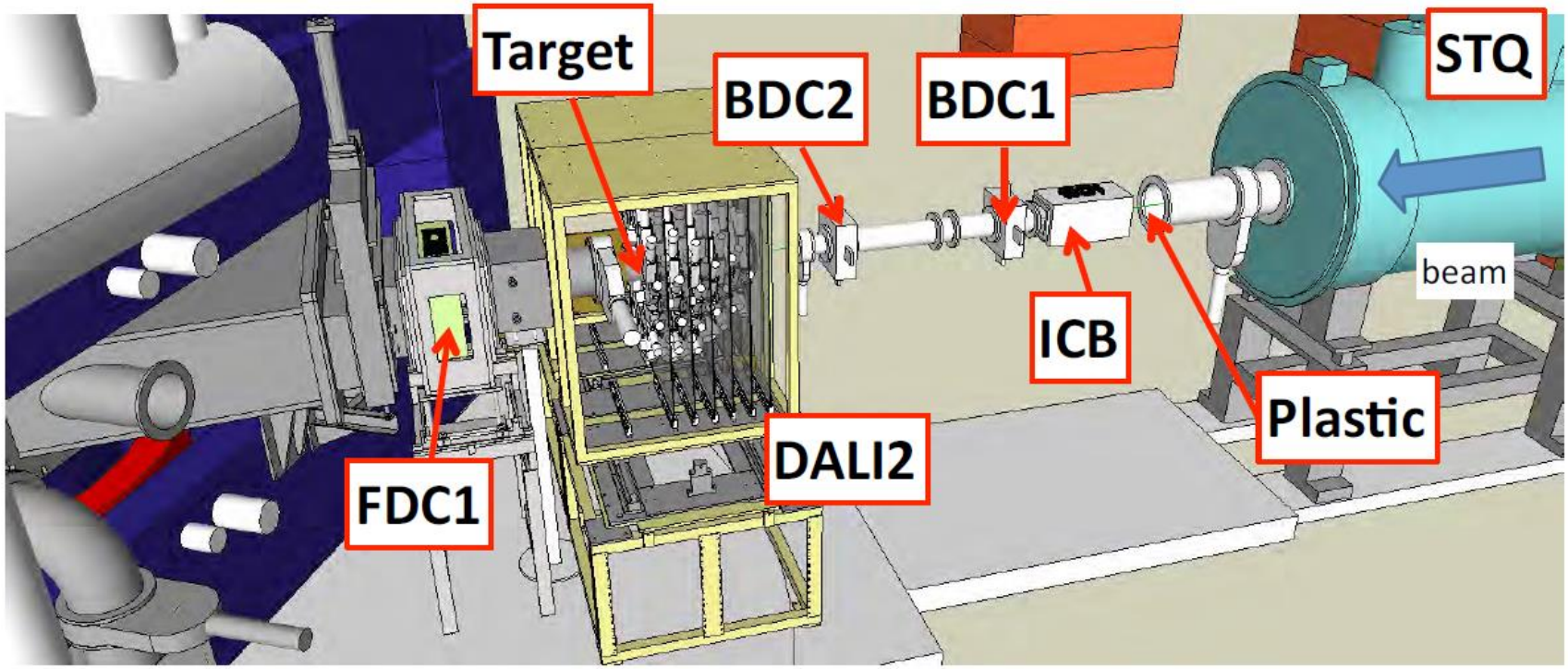
Possible to trace ^{136}Sn beam step by step

SMURAI Detector



Beam Profile Detector in SMURAI

- Detectors for incoming beams: beam position (BDC), PID(Plastic and ICB), γ(DALI2) and tracking detector(FDC1) for electro-magnetic spectroscopy at SAMURAI.



SMURAI BDC (Beam Drift Chamber)

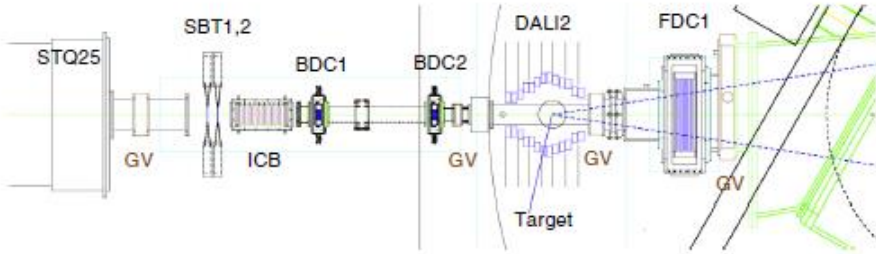


Fig. 6. Expanded view of the upstream part of the experimental setup.

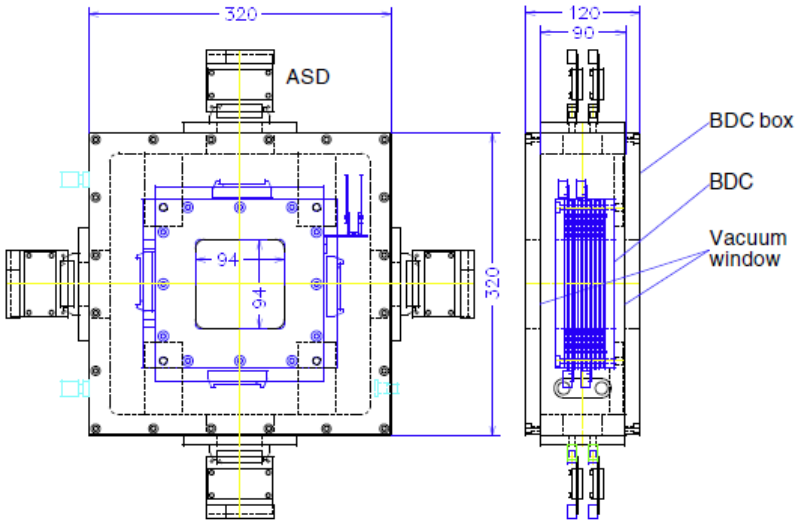
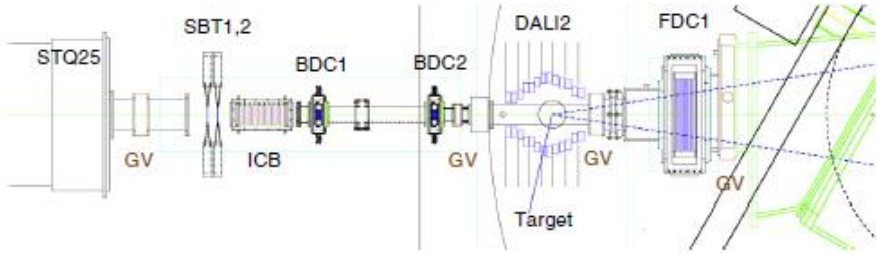


Fig. 9. Schematic view of the BDC and the BDC box.

NIMB 317 (2013) 294-304

- Walenta type Drift chamber
- 2.5 mm drift length
- i-C_4H_{10} at 50-100 torr
- Anode, potential wire diameter of 20 μm(Au-W), 80 μm(Au-Al)
- Cathode (gas window) 8 μm^t Al-Kapton
- Effective area : 8 cm x 8 cm

SMURAI BDC (Beam Drift Chamber)



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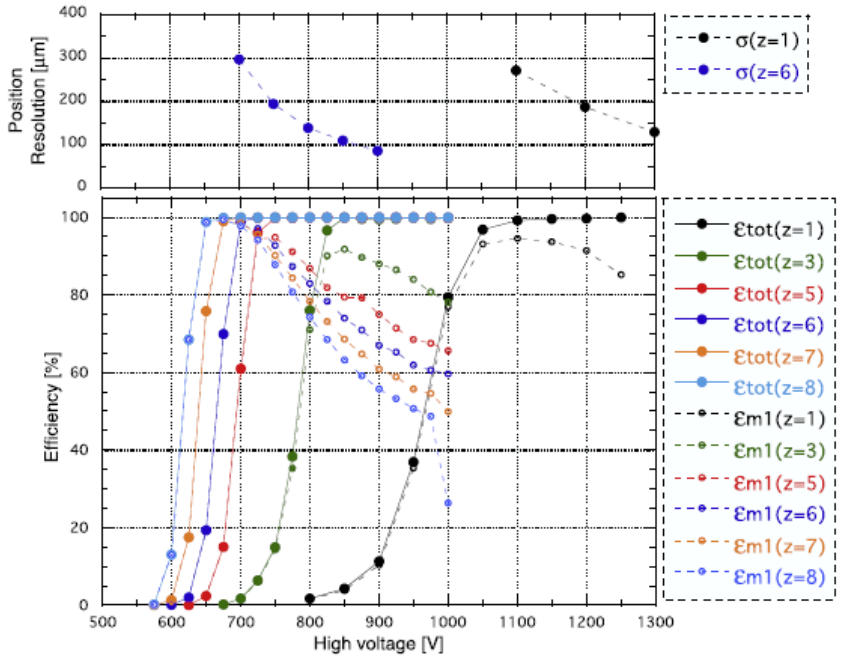

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Requirements

- Position resolution : ~ 100 μm
- Efficiency : 100 % at > 600 V

SMURAI BDC (Beam Drift Chamber)

- Beam Rate Estimation : LiSe++ (Seonghak Lee)

Fragment	Decay Type	Primary beam (400 kW)		Production Reaction	RI beam eneryg	RI beam Intensity	RI Beam purity
		Type	에너지 (MeV/u)		(MeV/u)	(pps)	(%)
132Sn	Beta- decay	238U	200	in-flight fission	**133.2**	**8.21E+06**	**1.4661**
130Sn	Beta- decay	238U	200	in-flight fission	**133.1**	**3.74E+08**	**13.6**
124Sn	stable	124Sn	230	transmission	**230**	**8.77E+13**	**100**
112Sn	stable	112Sn	263	transmission	**263**	**8.49E+13**	**100**

  - Expected Beam : ^{132}Sn : 8 x 10^{+6} pps with 133.2 MeV/u

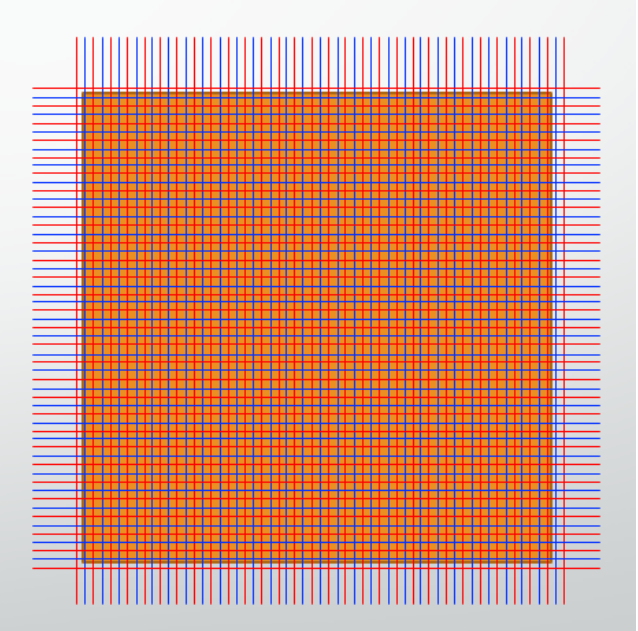
- To determine specific conditions of Drift Chamber, we will use GarField program (Dr. Hwang with Seonghak Lee)

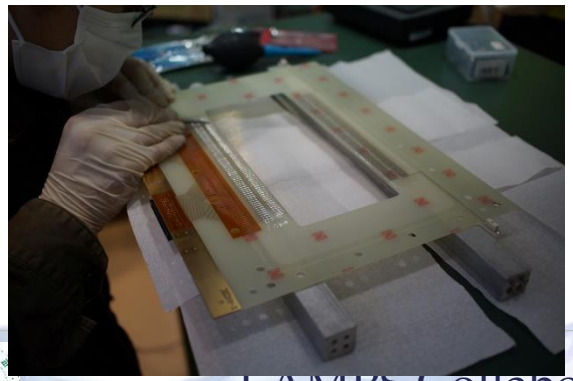
BDC Construction

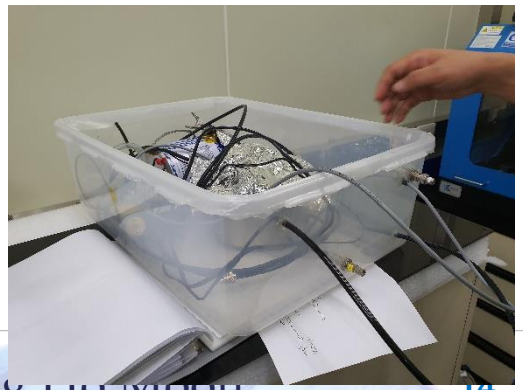
- Prototype Design

Configuration : xx'yy' (4 planes)
Sensor Wire : 32ch
Potential Wire : 33ch
Drift Length : 2.5 mm
32 * 2.5 * 2 = 160 mm

Active Area : 160 x 160 mm^2







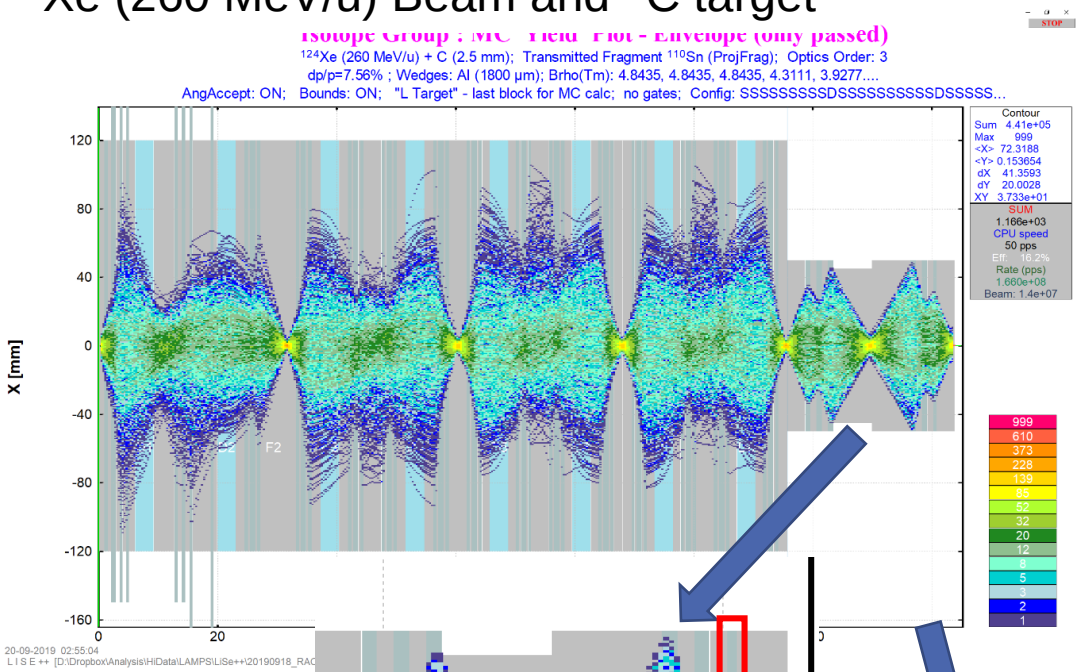
BDC Construction

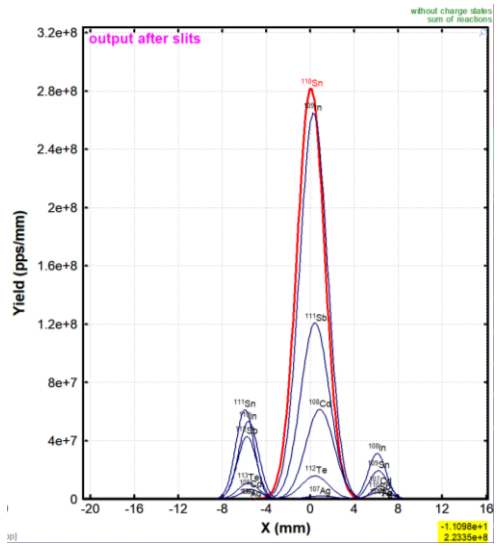
- NIM Crate & Power Supply & SH Cable

Place for wiring

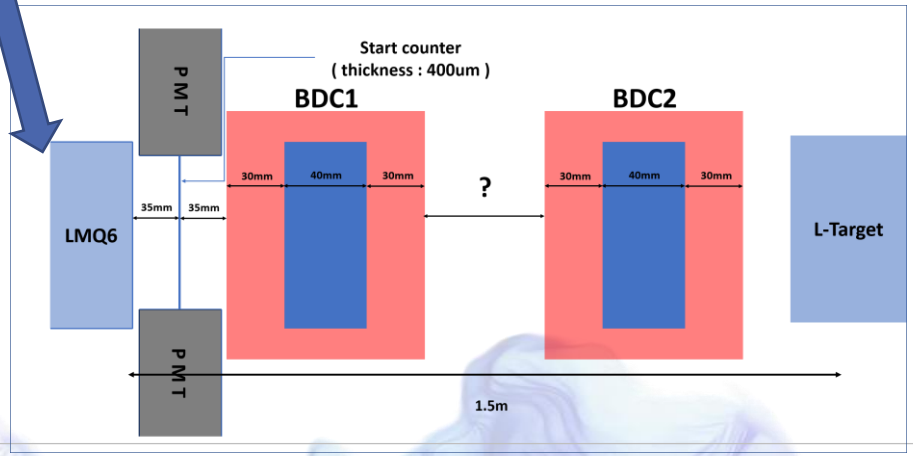
Beam Study with LiSe++

^{124}Xe (260 MeV/u) Beam and ^{14}C target



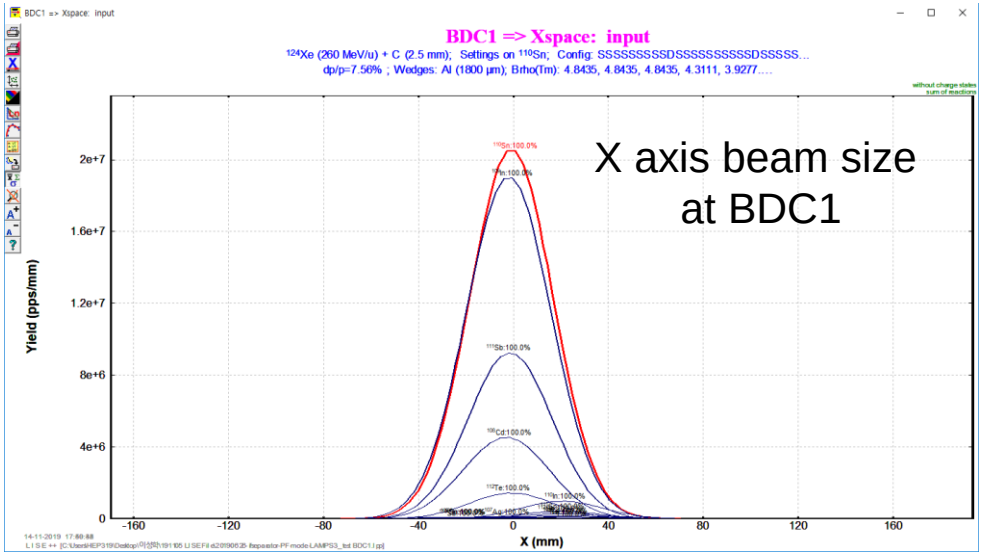


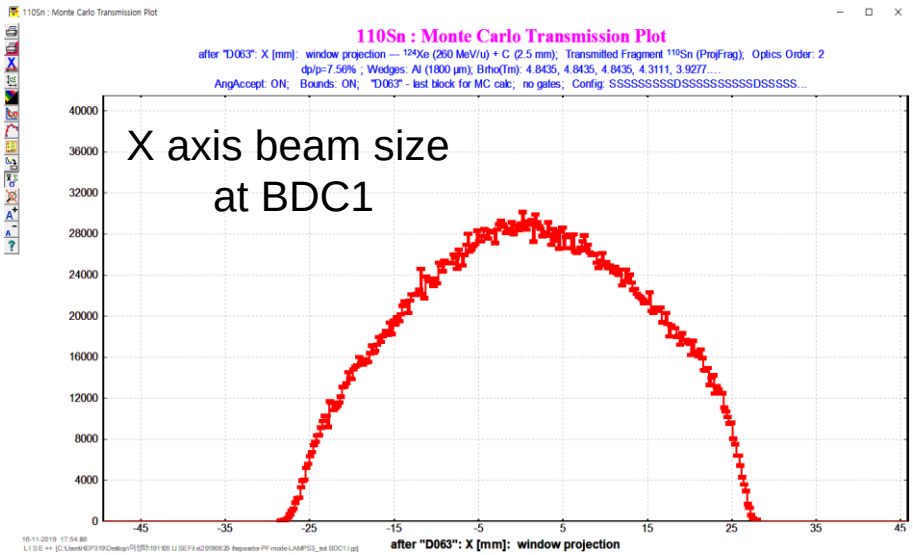
Beam size at L-Target (x)
: ± 4.2 mm



Beam Study with LiSe++

- Comparison of Distribution Method and MC Method



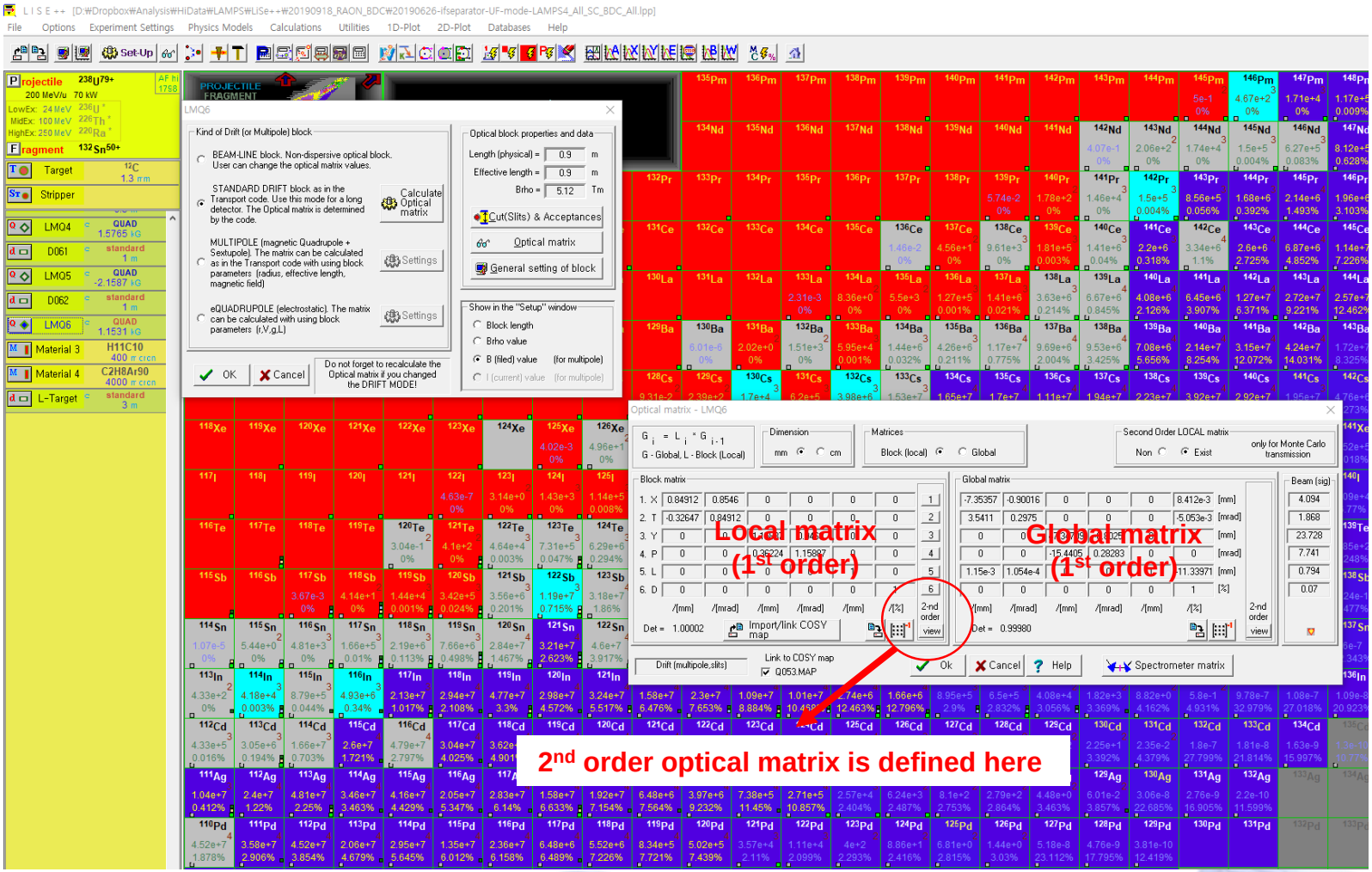


  - Distribution method : fast analytical method to calculate the fragment transmission through all optical blocks of the spectrometer.
  - MC method : developed for a qualitative analysis of fission fragment kinematics and utilized in the Kinematics calculator. (random event generation one by one)

- Distributions are quite different but MC method is more reliable due to considering more effect of optical matrix.

Beam Study with LiSe++

- MC method in IF system (possible up to 2nd order calculation)



Beam Study with LiSe++

- MC method in IF system (possible up to 2nd order calculation)

$$\begin{pmatrix} X_1 \\ \Theta_1 \\ Y_1 \\ \Phi_1 \\ L_1 \\ \delta_1 \end{pmatrix} = \begin{pmatrix} \text{1st order} \\ \text{Transformation} \\ \text{Matrix} \end{pmatrix} \begin{pmatrix} X_2 \\ \Theta_2 \\ Y_2 \\ \Phi_2 \\ L_2 \\ \delta_2 \end{pmatrix}$$

L : Beam pulse length

δ : Relative momentum dp/p

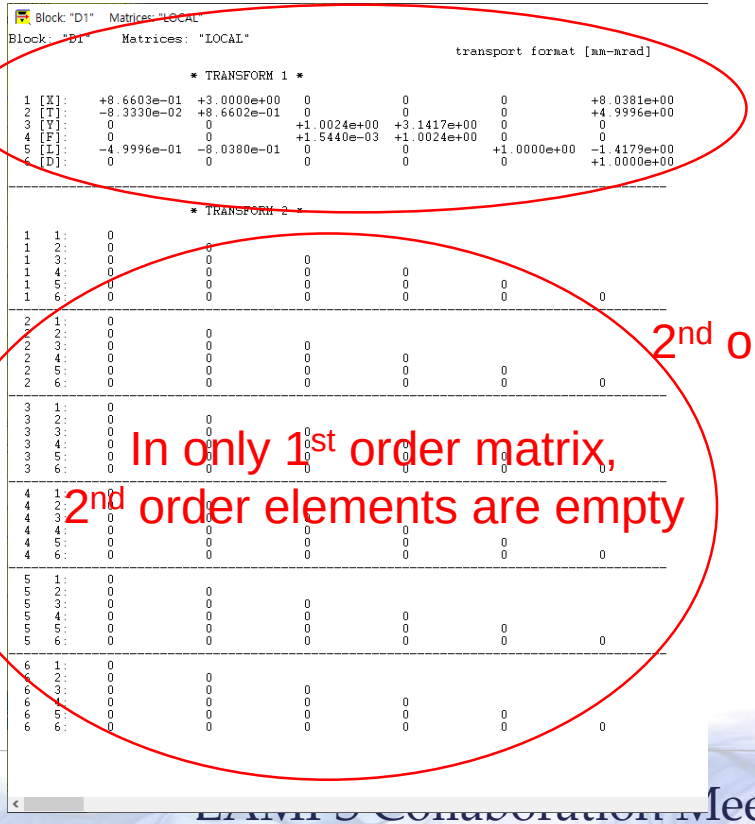
1st order matrix : 6 x 6

1st order calculation

X, **Θ, Y, Φ, L, δ**

2nd order calculation

X^2, Θ^2, Y^2, Φ^2, L^2, δ^2


Block: "D1" Matrices: "LOCAL"

transport format [mm-mrad]

* TRANSFORM 1 *

1 [X]:	+8.6603e-01	+3.0000e+00	0	0	0	+8.0381e+00
2 [T]:	-8.3330e-02	+8.6602e-01	0	0	0	+4.9996e+00
3 [Y]:	0	0	+1.0024e+00	+3.1417e+00	0	0
4 [F]:	0	0	+1.5440e-03	+1.0024e+00	0	0
5 [L]:	-4.9996e-01	-8.0380e-01	0	0	+1.0000e+00	-1.4179e+00
6 [D]:	0	0	0	0	0	+1.0000e+00

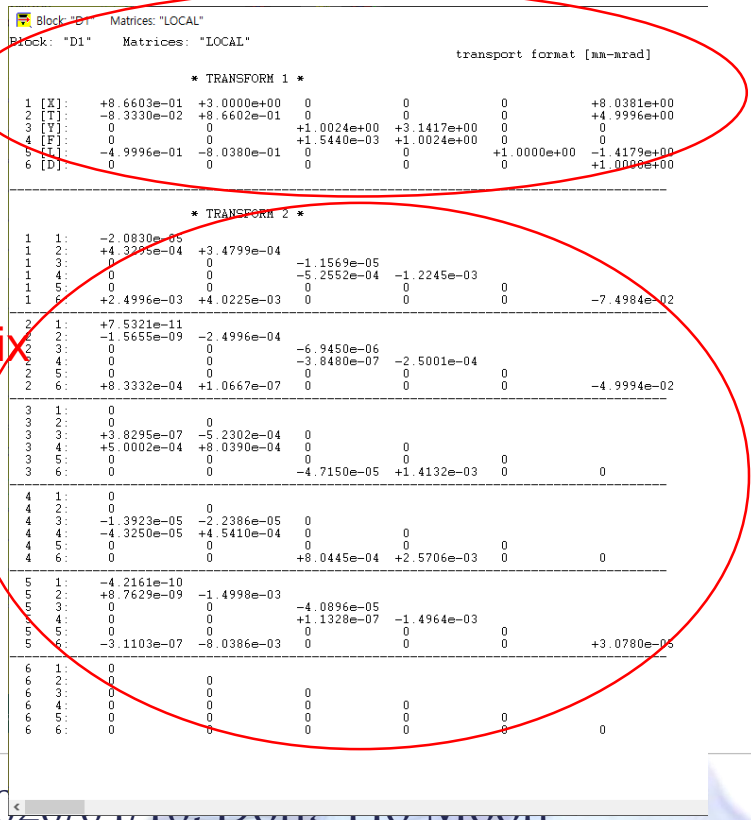
* TRANSFORM 2 *

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:	0	0	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:	0	0	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	0	0	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	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

2nd order matrix

In only 1st order matrix,

2nd order elements are empty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2 [T]:	-8.3330e-02	+8.6602e-01	0	0	0	+4.9996e+00
3 [Y]:	0	0	+1.0024e+00	+3.1417e+00	0	0
4 [F]:	0	0	+1.5440e-03	+1.0024e+00	0	0
5 [L]:	-4.9996e-01	-8.0380e-01	0	0	+1.0000e+00	-1.4179e+00
6 [D]:	0	0	0	0	0	+1.0000e+00

* TRANSFORM 2 *

1	1:	-2.0830e-05					
1	2:	+4.3295e-04	+3.4799e-04				
1	3:	0	0	-1.1569e-05			
1	4:	0	0	-5.2552e-04	-1.2245e-03		
1	5:	0	0	0	0	0	
1	6:	+2.4996e-03	+4.0225e-03	0	0	0	-7.4984e-02
2	1:	+7.5321e-11					
2	2:	-1.5655e-09	-2.4996e-04				
2	3:	0	0	-6.9450e-06			
2	4:	0	0	-3.8480e-07	-2.5001e-04		
2	5:	0	0	0	0	0	
2	6:	+8.3332e-04	+1.0667e-07	0	0	0	-4.9994e-02
3	1:	0					
3	2:	0	0				
3	3:	+3.8295e-07	-5.2302e-04	0			
3	4:	+5.0002e-04	+8.0390e-04	0	0		
3	5:	0	0	0	0	0	
3	6:	0	0	-4.7150e-05	+1.4132e-03	0	0
4	1:	0					
4	2:	0	0				
4	3:	-1.3923e-05	-2.2386e-05	0			
4	4:	-4.3250e-05	+4.5410e-04	0	0		
4	5:	0	0	0	0	0	
4	6:	0	0	+8.0445e-04	+2.5706e-03	0	0
5	1:	-4.2161e-10					
5	2:	+8.7629e-09	-1.4998e-03				
5	3:	0	0	-4.0896e-05			
5	4:	0	0	+1.1328e-07	-1.4964e-03		
5	5:	0	0	0	0	0	
5	6:	-3.1103e-07	-8.0386e-03	0	0	0	+3.0780e-05
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

Beam Study with LiSe++

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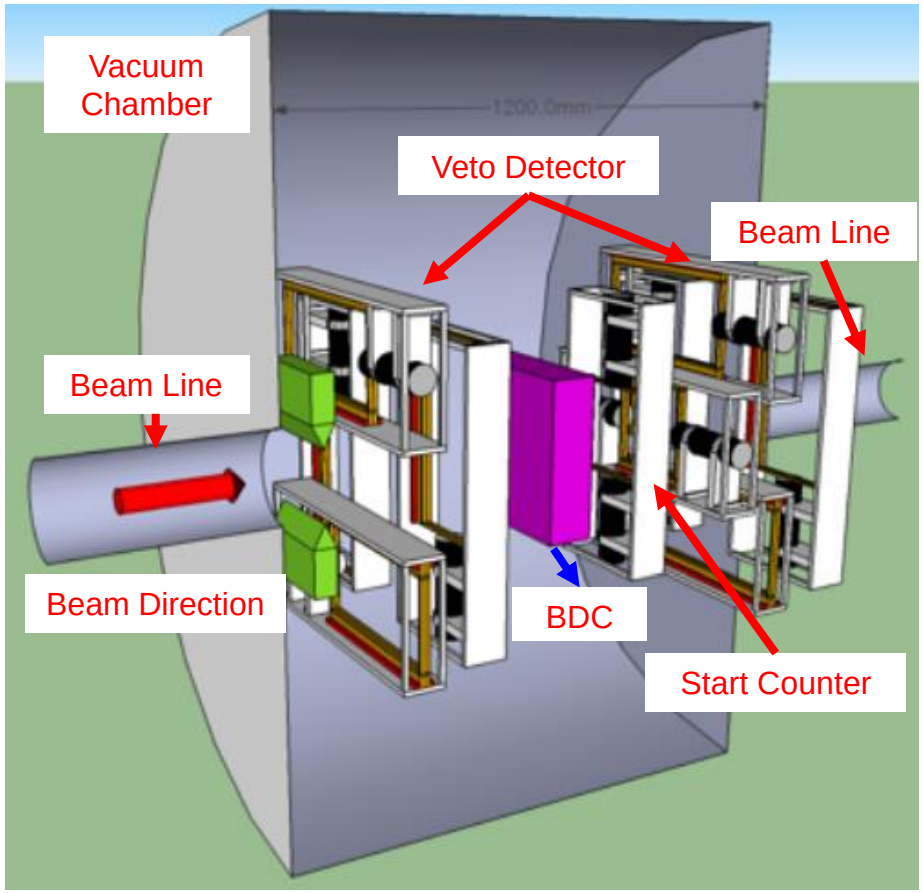

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