# Beam Size Study



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### LAMPS Workshop @ YeoSu

LAMPS Workshop @ Yeosu, 2019/07/05



## Simulation Setting at BigRISP

	Sn setting	<sup>238</sup> U beam
Primary beam	$^{238}U^{86+}$	Target
	345 MeV/nucleon	F0 F1
$B ho^{ m a)}$	8.004 Tm	D1 F2
Central particle <sup>b)</sup>	$^{136}$ Sn <sup>50+</sup>	Degrader D2
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	$+12.0/-18.0\mathrm{mm}$	
F7 slit	$+10.0/-10.0\mathrm{mm}$	
Average beam intensity <sup>c)</sup>	8.70 pnA	
Total dose	$1.95 \times 10^{16}$ 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) =  $6.24 \times 10^9$  particles/s.



### Schematic view of BigRIPS



### Schematic view of BigRIPS in LISE++

## **Beam Size Estimation**

### Monte Carlo Setting : One fragment ( $^{136}$ Sn) calculation, 3rd order calculation - x : -1.4 ~ 1.2 cm (2.6 cm), y : -1.2 ~ 1.2 cm (2.4 cm)



11-05-2019 23:50:20 LISE++ [C:\Users\u





### 2nd calculation



## **Beam Size Estimation**

### Monte Carlo Setting : Total Isotopes calculation, 3rd order calculation $-x: -1.5 \sim 2.0 \text{ cm} (3.5 \text{ cm}), y: -3.0 \sim 3.0 \text{ cm} (6.0 \text{ cm})$



**Total Isotopes calculation** 

### Issue : Not easy to run stably. LiSe++ simulation took long time (~ days) and often died.

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**Projection X FWHM : 14.75mm** 

## **Envelop process**



Beam process for only <sup>136</sup>Sn

### Issue : processing of envelop for all nuclear stops during the calculation very often.

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Beam process for all isotopes

## **Purity Study**

120Tc 120Tc 120Tc 120Tc 120Tc 120Tc	43 43 43 43 43	43 43 43 43 43	43 43 43 43 42	43 43 43 43 42	43 43 43 43 42	43 43 43 43 42	43 42 42 42 43	42 AL 43 AH 43 AL 42 AL 43 AL	2.12e-07 1.22e-09 1.38e-07 4.19e-09 3.05e-09	7.97e-03 5.66e-03 5.20e-03 1.58e-04 1.15e-04	1.36e-09 1.10e-11 1.36e-09 1.36e-09 1.36e-09	87.58 87.58 87.58 87.58 87.58 87.58	100 100 100 100 100	96.01 98.56 96.01 96.01 96.01	73.15 73.26 73.15 73.15 73.15 73.15	100 100 100 100 100	19.99 16.01 19.99 19.99 19.99	93.25 93.25 93.25 93.25 93.25 93.25 93.25	100 100 100 100 100	3.143 3.640 3.143 3.143 3.143 3.143	100 100 100 100 100 100	10 10 10 10
1201C 119Tc 119Tc 119Tc 119Tc 119Tc 119Tc 119Tc	43 43 43 43 43 43	43 43 43 43 43 43 43	43 43 43 43 43 43 42	43 43 43 43 43 42	43 43 43 43 43 43 42	43 43 43 43 43 43 42	43 43 43 42 42 42 43	Sum 43   AH 43   AL 42   AL 43   AL 42   AL 43   AL	7.92e-06 2.77e-09 7.26e-07 2.00e-08 1.32e-08 3.89e-10 3.01e-10	1.05e-03 9.16e-04 2.52e-05 1.66e-05 4.91e-07 3.80e-07	1.34e-10 4.05e-08 4.05e-08 4.05e-08 4.05e-08 4.05e-08 4.05e-08	87.59 87.59 87.59 87.59 87.59 87.59 87.59 87.59	100 100 100 100 100 100	98.07 94.94 94.94 94.94 94.94 94.94 94.94	67.68 68.10 68.10 68.10 68.10 68.10 68.10	100 100 100 100 100 100	10.3114.0314.0314.0314.0314.0314.03	93.30 93.30 93.30 93.30 93.30 93.30 93.30	100 100 100 100 100 100	0.024 0.016 0.016 0.016 0.016 0.016 0.016	100 100 100 100 100 100 100	1( 1( 1( 1( 1(
120Mo	42	42	42	42	42	42	42	42 AL	8.18e-10	5.35e+00	7.81e-15	87.97	100	95.43	84.76	100	38.92	93.32	100	30.05	100	10
119Mo 119Mo 119Mo 119Mo	42 42 42 42	42 42 42 42	42 42 42 42	42 42 42 42	42 42 42 42	42 42 42 42	42 42 42 41	42 AH 42 AL 41 AL 42 AL	3.15e-10 3.15e-09 5.33e-08 1.34e-09 6.91e-10	3.84e-01 3.14e-01 7.90e-03 4.07e-03	4.19e-13 8.68e-12 8.68e-12 8.68e-12 8.68e-12	87.98 87.98 87.98 87.98 87.98	100 100 100 100	98.76 94.72 94.72 94.72	82.31 80.85 80.85 80.85	100 100 100 100	30.49 33.90 33.90 33.90 33.90	93.37 93.37 93.37 93.37 93.37	100 100 100 100	2.541 2.141 2.141 2.141 2.141	100 100 100 100	1( 1( 1( 1(
118Mo	42 42	42 42	42 42	42 42	42 42	42 42	42 42	42 AL  41 AL	5.90e-09 1.45e-10	1.08e-03 2.64e-05	2.80e-10 2.80e-10	87.99 87.99	100 100	95.41 95.41	76.88 76.88	100 100	26.92 26.92	93.42 93.42	100 100	0.009 0.009	100 100	1( 1(
89Br	34	35	34	34	35	35	35	35   AL	8.76e-09	2.07e-13	2.16e+00	0.583	100	68.44	38.48	100	0.201	94.75	100	0.000	100	10
88Br	34	35	34	34	35	35	35	35 AL	1.24e-08	1.63e-13	3.89e+00	0.584	100	67.31	32.90	100	0.000	94.78	100	0.009	100	10
87Se	33 33	34 34	33	33 33	34 34	34 34	34 34	Sum 34 AM  34 AL  Sum	1.02e-08 1.03e-08	1.44e-13 4.78e-13	3.82e-02 1.08e+00	0.475	100 100	76.72 66.83	41.20 42.74	100 100	0.312	94.83 94.83	100 100	0.000	100 100	1(
86Se   86Se	33 33	34 34	33	33	34 34	34 34	34 34	34 AM  34 AL	1.18e-07 2.47e-05	2.16e-11 7.32e-10	2.79e-01 1.72e+00	0.476	100 100	74.79 63.77	35.11 36.84	100 100	0.005	94.86 94.86	$100 \\ 100$	0.153 0.209	100	1(1)
86Se   85As	32	33	32	32	33	33	33	Sum  33 AL	2.48e-05 2.57e-08	3.69e-12	3.56e-01	0.386	100	65.79	47.25	100	4.273	94.90	100	0.000	100	1(
84As	32 32	33 33	32 32	32 32	33 33	33 33	33 33	33 AH 33 AH	9.38e-08 1.07e-06	1.05e-10 4.95e-10	4.57e-02 1.11e-01	0.387 0.387	100 100	83.93 74.16	38.21 39.36	100 100	0.036 0.183	94.93 94.93	100 100	0.114 0.116	100 100	1( 1(
84As	32	33	32	32	33	33	33	33 AL	3.14e-05	2.32e-09	6.90e-01	0.387	100	63.80	40.98	100	0.968	94.93	100	0.115	100	10



### **Purity definition = <sup>136</sup>Sn rate/All isotopes rate**

<sup>136</sup>Sn rate in all reactions : ~ 10.1 %

136 cn 50+..50+

8.0040 T

beam-lin 3.48 m

slits

Al 2.82 mm

slits

beam-lin 4.4 m

slits

Brho 7.4946 Tr

Drift 2

F1 slit

D2

F2 slit

H +120

GANIL

n: 11.0.19

🖤 🌹 F1 Wedge

d 🗖 F2-F2,5 drift ST F2,5 slit

<sup>9</sup>Be 2.92 mm

FRAGMENT	<b>•</b>	-1-1	••		Mat	141Cs	142Cs	143Cs	144 <sub>Cs</sub>	145Cs	146	
130xe 131xe 132xe 1	33Xe 134Xe	135Xp	136xe	137Xe	138xe	139Xe	140Xe	141Xe	142 X e	143Xe	144Xe	145
			λ.			~~	~~			~~		
129  130  131  1	32  133	134j	135	136	137	138	139	140	141	142 8.44e-10	143 2.16e-8	<b>144</b> 3.030
<sup>128</sup> Te <sup>129</sup> Te <sup>130</sup> Te <sup>1</sup>	<sup>31</sup> Te <sup>132</sup> Te	<sup>133</sup> Te	<sup>134</sup> Te	<sup>135</sup> Te	<sup>136</sup> Te	<sup>137</sup> Te	<sup>138</sup> Te 5	<sup>139</sup> Te	<sup>140</sup> Te 11	<sup>141</sup> Te 16	<sup>142</sup> Te 12	143
	30 01 434 01	422.01	422.01	124.01	425.01	6.55e-10 0%	2.72e-6	2.1e-5 0%	1.21e-5 0%	4.24e-2 0.001%	2.07e-2 0.077%	1.59 0.56
121 SD 120 SD 120 SD 1	50 SD 151 SD	132 SD	133 SD	134 50	8.15e-6	1.09e-4	2.22e-4	2.09e-3	1.54e-1	1.87e-2	9.76e-4	1.81
126 Sn 127 Sn 128 Sn 1	29 Sn 130 Sn	131 Sn	132 Sn	133 Sn	134 Sn	135 Sm	136 Sn	137 Sn	0.049% 138 Sn	0.424% 139 Sn	1.740% 140 Sn	3.30. 141
	8	3 2.06e-8 0%	6.78e-4 0%	9 6.02e-3 0%	22 1.22e-2 0%	3.4e- 0.004%	34 4.65e-1 0.082%	24 1 18e-1 1.546%	14 7.24e-3 1.387%	<b>11</b> 1.55e-4 3.718%	8 7.29e-6 5.933%	1.72e 8.44
125 <sub> n</sub> 126 <sub> n</sub> 127 <sub> n</sub> 1	28 n 129 n	<sup>130</sup> In 5 650-4	131In 18	<sup>132</sup> In 32	<sup>133</sup> In 35	<sup>134</sup> In 29	17 2 10-2	<sup>136</sup> In	137In 11	<sup>138</sup> In 3	<sup>139</sup> In 2 3e-10	140
ا من اللہ اللہ	0.336-0	0%	0%	0.004%	0.081%	0.587%	1.496%	2.846%	6.106%	8.998%	12.492%	
<sup>124</sup> Cd <sup>125</sup> Cd <sup>126</sup> Cd <sup>1</sup>	<sup>27</sup> Cd <sup>128</sup> Cd	<sup>129</sup> Cd	<sup>130</sup> Cd	<sup>131</sup> Cd	<sup>132</sup> Cd	<sup>133</sup> Cd	<sup>134</sup> Cd	<sup>135</sup> Cd	136Cd	<sup>137</sup> Cd	<sup>138</sup> Cd	139
1.32e-9 9.5 0%	51e-7 4.73e-2 0% 0%	3.01e-1 0.004%	4.28e-1 0.092%	1.54e-1 0.634%	1.74e-2 1.595%	1.99e-3 3.061%	1.37e-4 6.285%	1.25e-8 9.333%	2.7e-9 12.923%			
<sup>123</sup> Ag <sup>124</sup> Ag <sup>125</sup> Ag <sup>1</sup>	<sup>26</sup> Aa <sup>127</sup> Aa	<sup>128</sup> Aa	<sup>129</sup> Aa	<sup>130</sup> Aa	<sup>131</sup> Aa	<sup>132</sup> Ag	<sup>133</sup> Ag	<sup>134</sup> Ag	<sup>135</sup> Ag	<sup>136</sup> Ag	<sup>137</sup> Ag	138
6.22e-6 <b>1.6</b> 0%	67e-1 3.52e-1 0% 0.075%	1.9e-1 0.594%	4.88e-2 1.577%	2.62e-3 3.095%	3.53e-4 5.327%	2.52e-5 9.427%	1.08e-8 13.219%					
122Pd 123Pd 124Pd 1	<sup>26</sup> Pd <sup>126</sup> Pd	<sup>127</sup> Pd	<sup>128</sup> Pd	<sup>129</sup> Pd	<sup>130</sup> Pd	<sup>131</sup> Pd	<sup>132</sup> Pd	<sup>133</sup> Pd	<sup>134</sup> Pd	<sup>135</sup> Pd		137
46e-6 8.6e-2 3.87e-1 1.6 0% 0% 0.019% 0.	61e-1 4.46e-2 58% 1.585%	7.55e-3 3.127%	1.13e-3 5.514%	5.65e-5 8.485%	1.19e-5 13.339%	2.53e-6 17.336%						

<sup>136</sup>Sn rate : 4.65x10<sup>-1</sup> [pps] in all reactions

## Summary & Plan

### Summary

- Estimated beam size of <sup>136</sup>Sn is 2.6cm for X and 2.4cm for Y.
- > Estimated beam size of all isotope is 3.0cm for X and 6.0cm for Y.
- > Purity is ~ 10.1% ( $^{136}$ Sn rate/All isotope).

### Plan

Plan to simulate IF System on RAON instead of BigRISP.

Start to involve in assembly of BDC.

