S-2S meeting

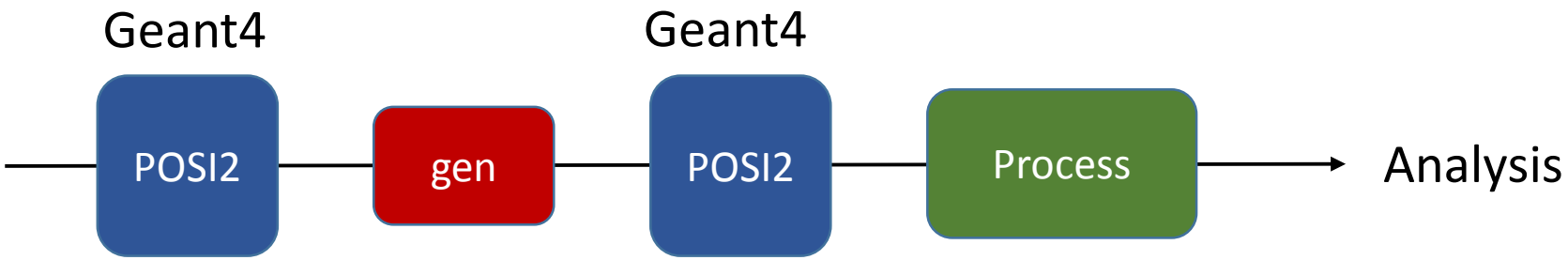
京都大学
KYOTO UNIVERSITY
Toshiyuki Gogami

4Aug2014

Contents

- Missing mass resolution study
- J-PARC/KEK tour (7/29, 7/30)
- CAD drawing of water Cerenkov detector

Flow of Monte Carlo simulation



K^- energy loss

K^+ energy loss

(K^-,K^+) kinematics

Missing mass reconstruction
Momentum resolution
Angular resolution
Vertex resolution

Particle generation

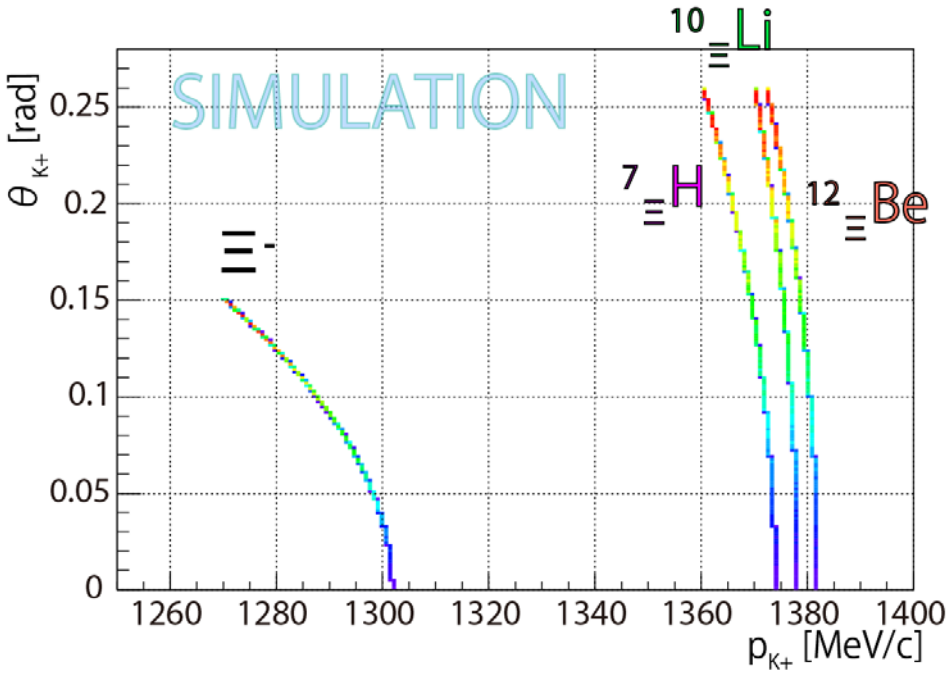


Fig: Particle distributions in the simulation

K^- momentum:

✓ 1800 MeV/*c*

K^+ momentum:

✓ Uniform

✓ 1270 – 1470 GeV/*c*

K^+ angle:

✓ Spherical uniform

✓ 0.0 – 0.26 rad

Assumed Ξ's binding energy:

✓ $^{7}_{\Xi}$H: 0.0 MeV

✓ $^{10}_{\Xi}$Li: 0.0 MeV

✓ $^{12}_{\Xi}$Be: 4.5 MeV

Each term contribution to the missing mass resolution

Missing mass, M_H

$$M_H^2 = (E_1 + m_t - E_2)^2 - (\vec{p_1} - \vec{p_2})^2$$

$$\left(\frac{\partial M_H}{\partial p_1}\right)\Delta p_1 = \frac{1}{M_H}\left[\frac{p_1}{E_1}(m_t - E_2) + p_2\cos\theta\right]\Delta p_1$$

$$\left(\frac{\partial M_H}{\partial p_2}\right)\Delta p_2 = \frac{1}{M_H}\left[-\frac{p_2}{E_2}(m_t + E_1) + p_1\cos\theta\right]\Delta p_2$$

$$\left(\frac{\partial M_H}{\partial \theta}\right)\Delta\theta = -\frac{p_1 p_2}{M_H}\sin\theta\cdot\Delta\theta$$

(Missing mass に対する各項の寄与)

Calculated event by event

→ Mean values will be shown in results.

Each term contribution to the missing mass resolution

Missing mass, M_H

$$M_H^2 = (E_1 + m_t - E_2)^2 - (\vec{p_1} - \vec{p_2})^2$$

$$\left(\frac{\partial M_H}{\partial p_1}\right)\Delta p_1 = \frac{1}{M_H}\left[\frac{p_1}{E_1}(m_t - E_2) + p_2\cos\theta\right]\Delta p_1$$

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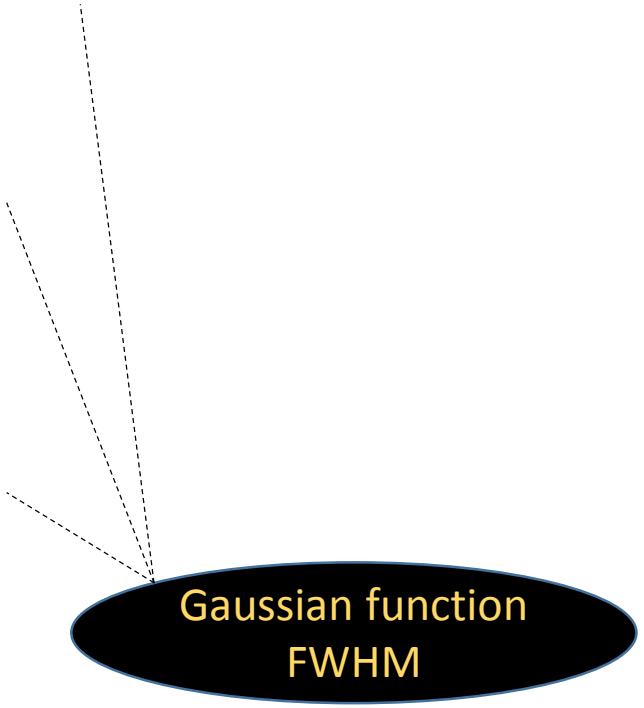
(Missing mass に対する各項の寄与)

Calculated event by event

→ Mean values will be shown in results.

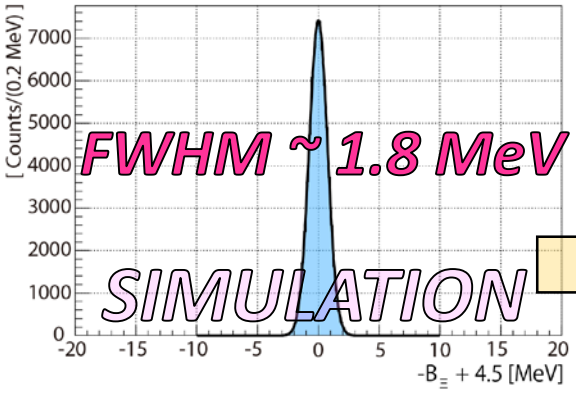
Assumptions

- K^- momentum resolution, $\Delta p_1/p_1$ = **1.0E-3**
- K^+ momentum resolutions, $\Delta p_2/p_2$
  - ✓S-2S: **5.0E-4**
  - ✓SKSPlus: **2.0E-3**
  - ✓SKSMinus: **2.7E-3**
- Angular resolution, $\Delta\vartheta$ = **2 mrad**



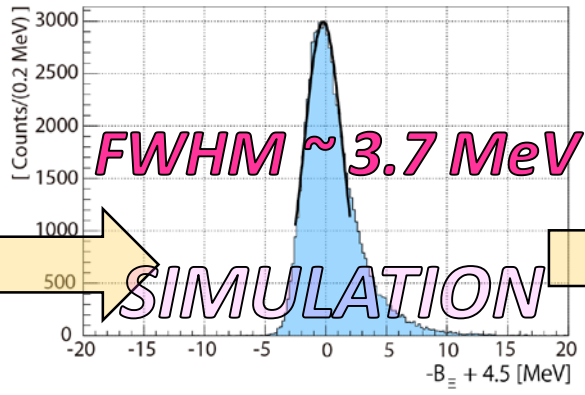
Examples (with S-2S, 9.3 g/cm^2 CH_2)

①



Momentum resolution

②

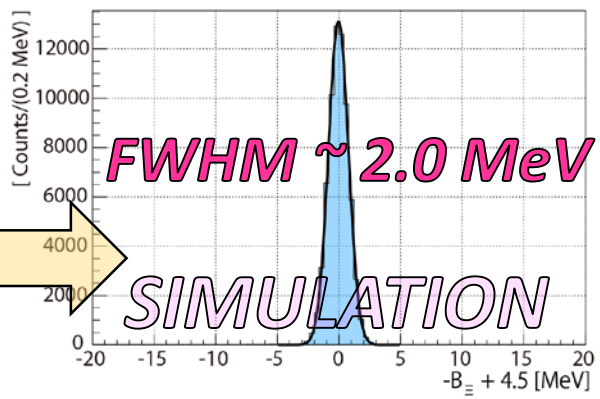


Momentum resolution

✚

Target

③



Momentum resolution

✚

Target

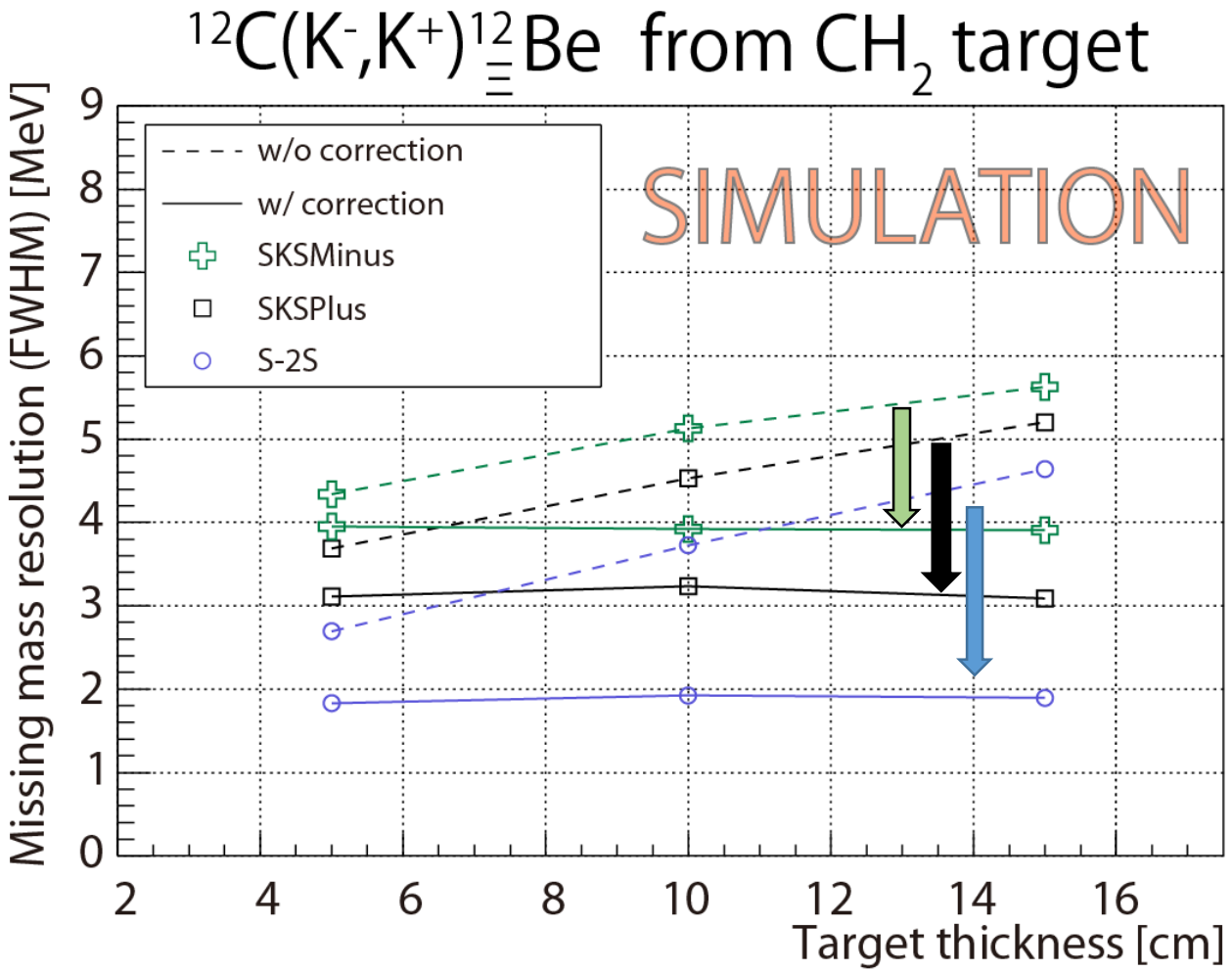
✚

Energy loss correction

Missing mass resolutions (bug fixed)

		Results (FWHM) [MeV]				Remarks
Target [g/cm^2]		-	-	-	CH_2 (4.65/9.30)	
Reaction		$p(K^-,K^+)\Xi$	^{7}Li$(K^-,K^+)^7_\Xi$H	^{10}B$(K^-,K^+)^{10}_\Xi$Li	^{12}C$(K^-,K^+)^{12}_\Xi$Be	
Intrinsic Resolution (S−2S)	p_{K-}	1.16	1.62	1.66	1.67	Calculations
	p_{K+}	-0.38	-0.57	-0.58	-0.59	
	θ_K	-0.52	-0.18	-0.13	-0.11	
	Total	1.3	1.73	1.76	1.77	Quadratic sum
Simulation w/o target (S-2S)		1.29	1.73	1.77	1.78	
Simulation w/o target (SKSPlus)		2	2.9	3	3	
Simulation w/ target w/o correction (S-2S)					2.7 / 3.7	
Simulation w/ target w/o correction (SKSPlus)					3.7 / 4.5	
Simulation w/ target w/ correction (S-2S)					1.8 / 1.9	dE vs. MM rough linear correction
Simulation w/ target w/ correction (SKSPlus)					3.1 / 3.2	dE vs. MM rough linear correction

Missing mass resolutions vs. Target thickness



Summary

$^{12}C(K^-,K^+)^{12}_{\Xi}Be$

S-2S + CH_2 (4.65/9.30/13.95 [g/cm^2]) + energy loss correction:

→ ΔM_H ~ ***2*** **MeV** (FWHM)

SKSMinus + CH_2 (4.65/9.30/13.95 [g/cm^2]) + energy loss correction:

→ ΔM_H ~ ***4*** **MeV** (FWHM)

The natural width was not taken into account.
dE resolution was not considered.
Effect of the inverse transfer matrix is zero.
Assumed resolutions are the following:

K^-: $\frac{\Delta p}{p} = 1.0 \times 10^{-3}$,

K^+: $\frac{\Delta p}{p} = 5.0 \times 10^{-4}$ (S-2S), 2.7×10^{-3} (SKSMinus),

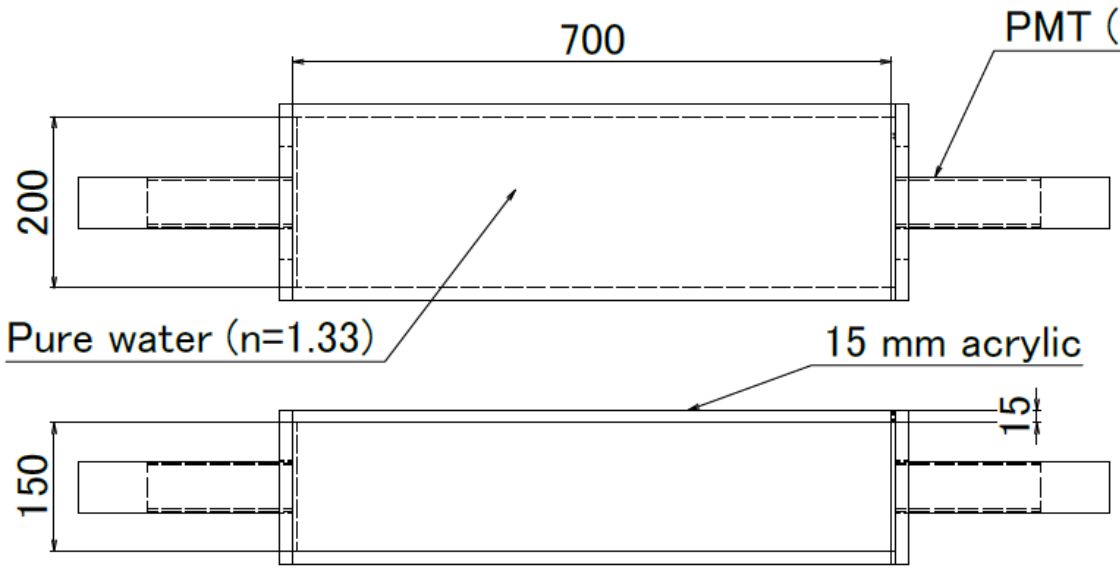
$\Delta\vartheta$ = *2.0 mrad* .

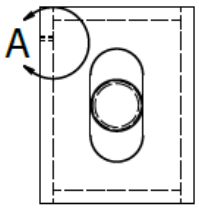
J-PARC tours with M1 students

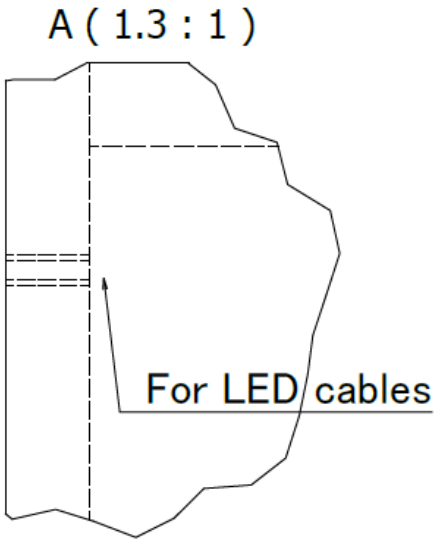
7/29 @ J-PARC
7/30 @ J-PARC / KEK

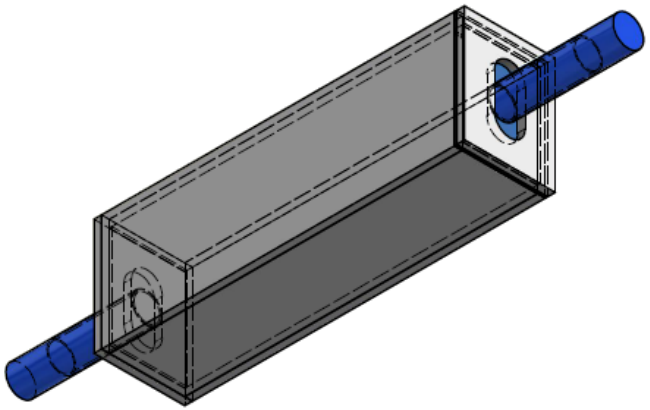
http://www-nh.scphys.kyoto-u.ac.jp/~gogami/pictH/pict_e05.html

CAD drawing of prototype of Water Cerenkov detector (1)



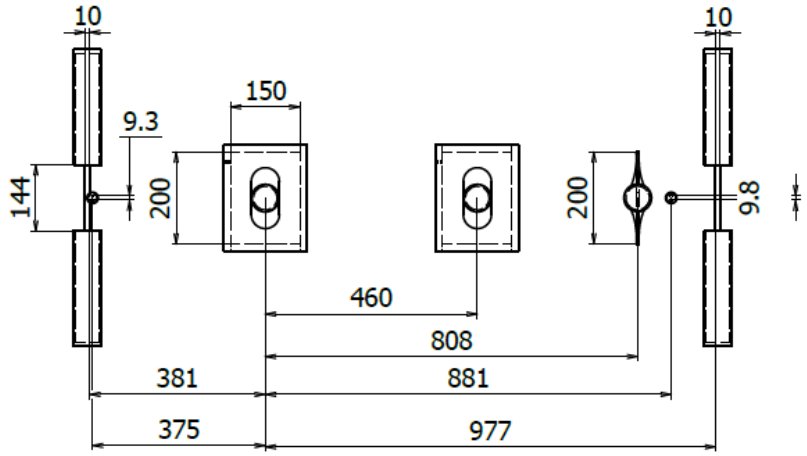


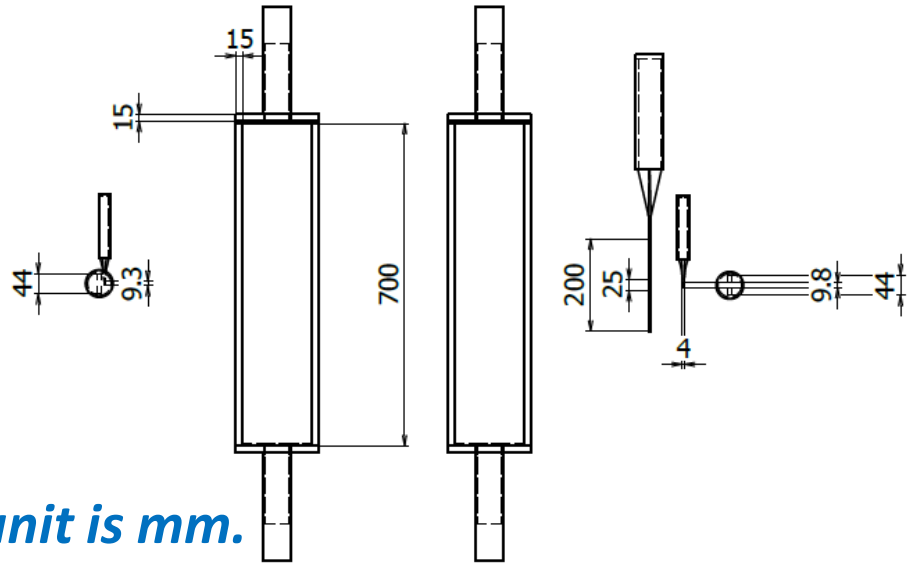


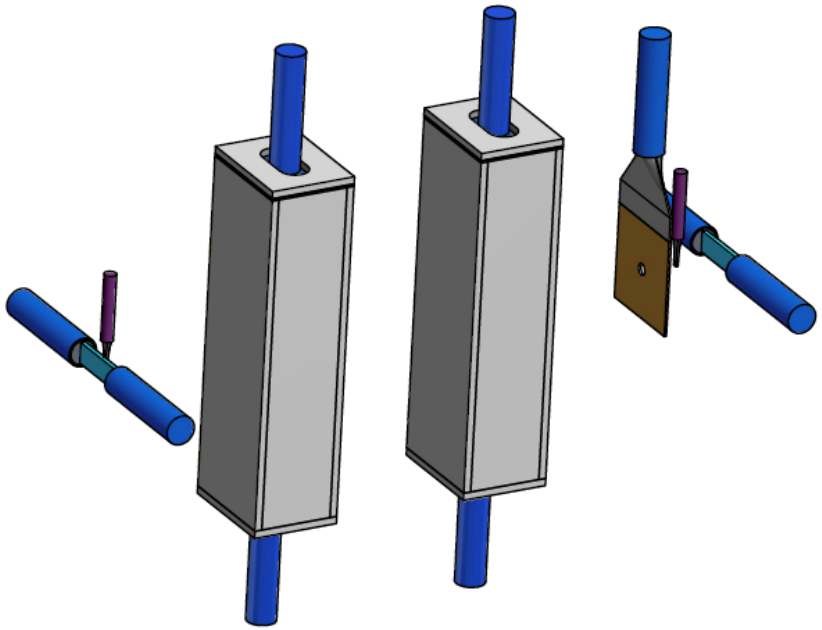


The unit is mm.

CAD drawing of prototype of Water Cerenkov detector (2)



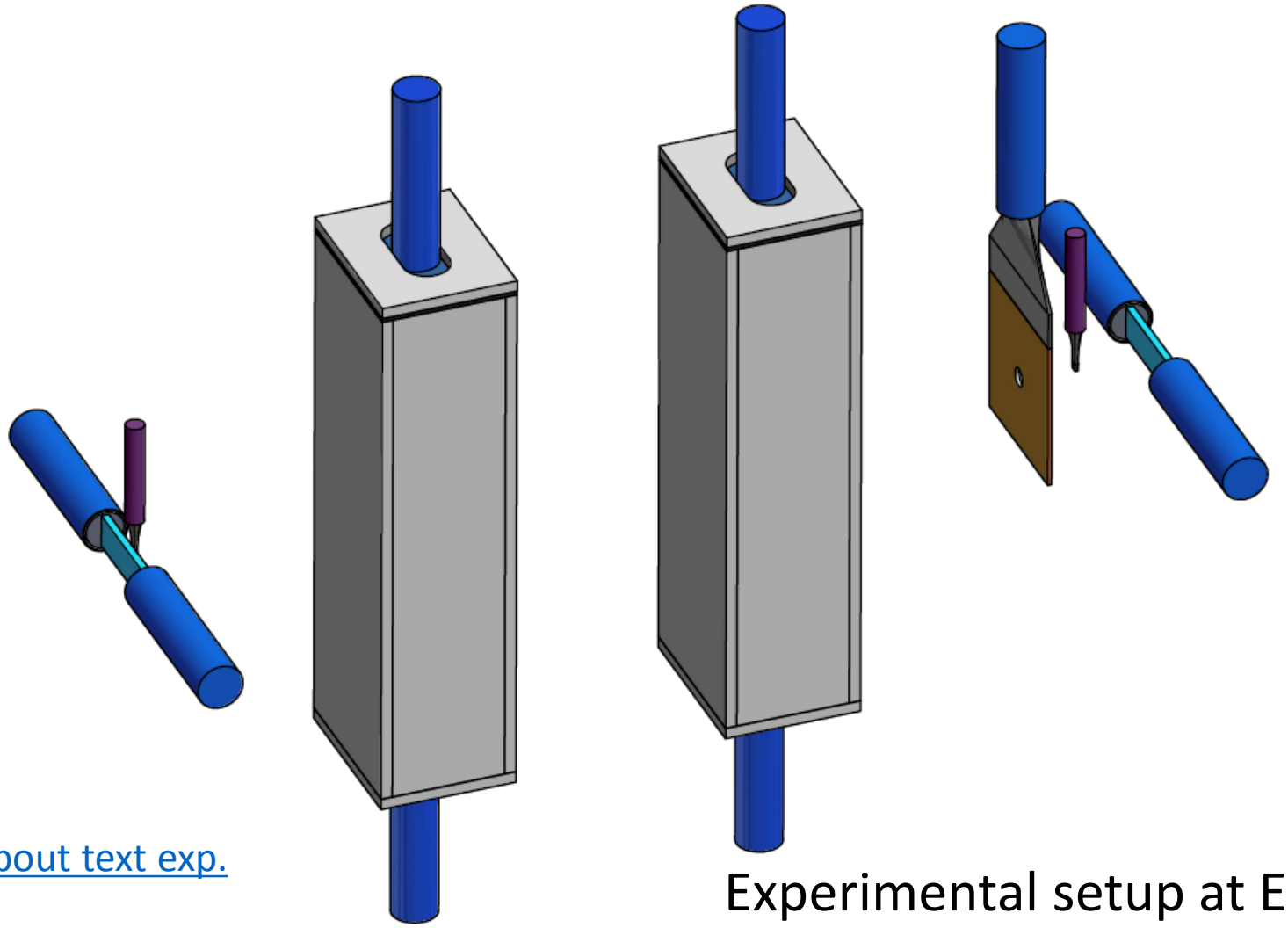




Experimental setup at ELPH

The unit is mm.

CAD drawing of prototype of Water Cerenkov detector (3)



Memo about text exp.

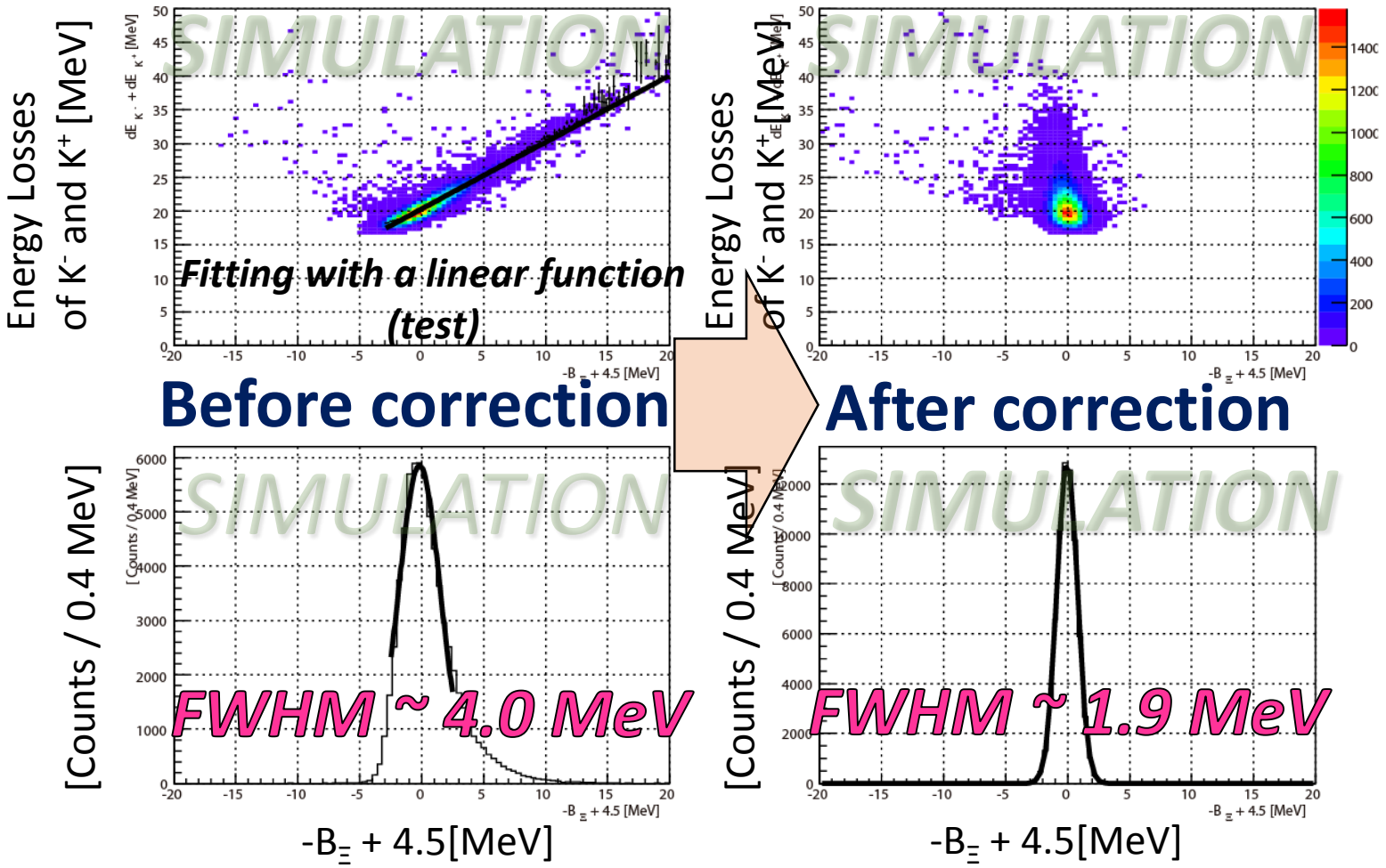
Experimental setup at ELPH

Outlook

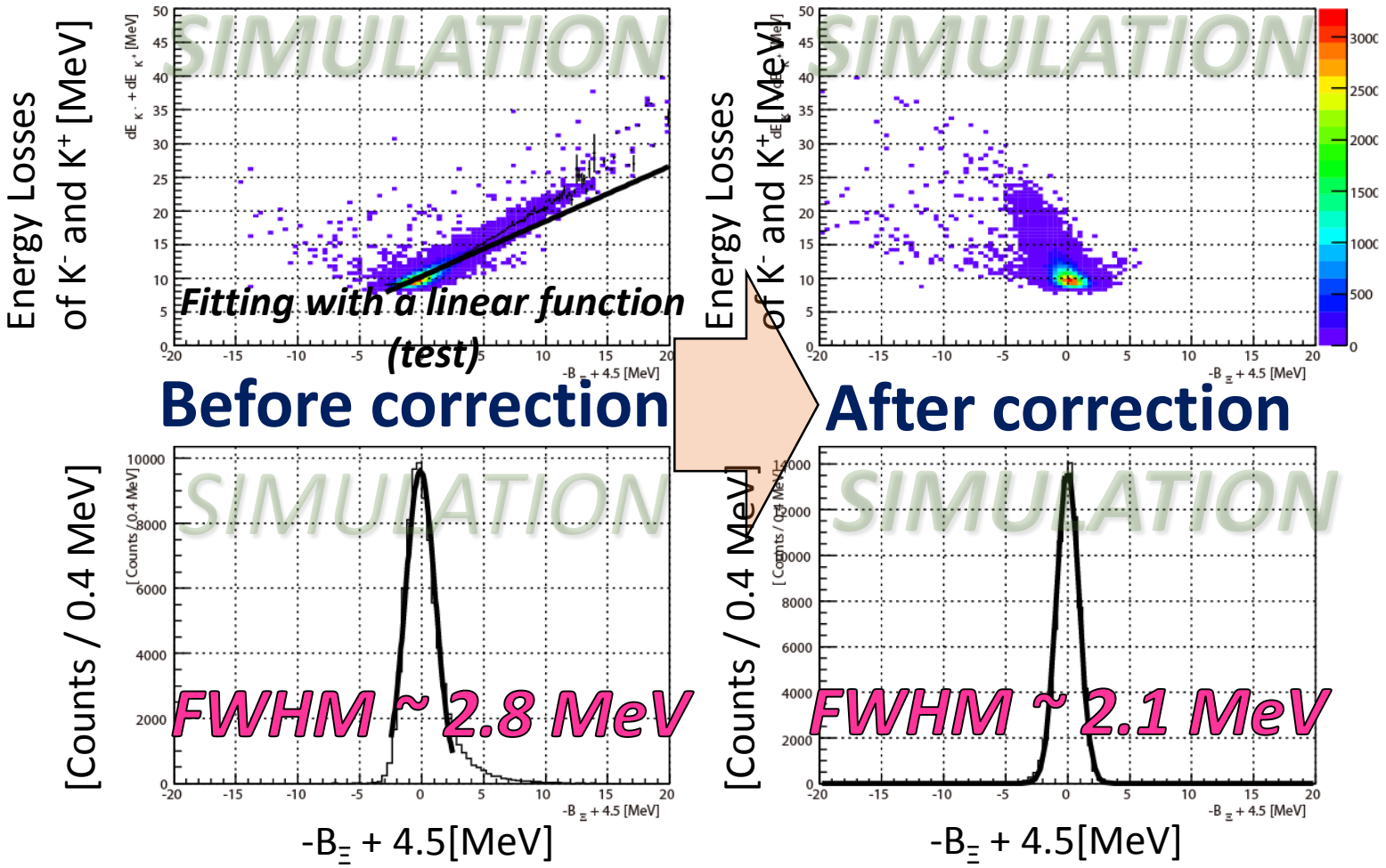
- Simulation study with SKS (S-2S) spectrometer
- CAD models

Backup

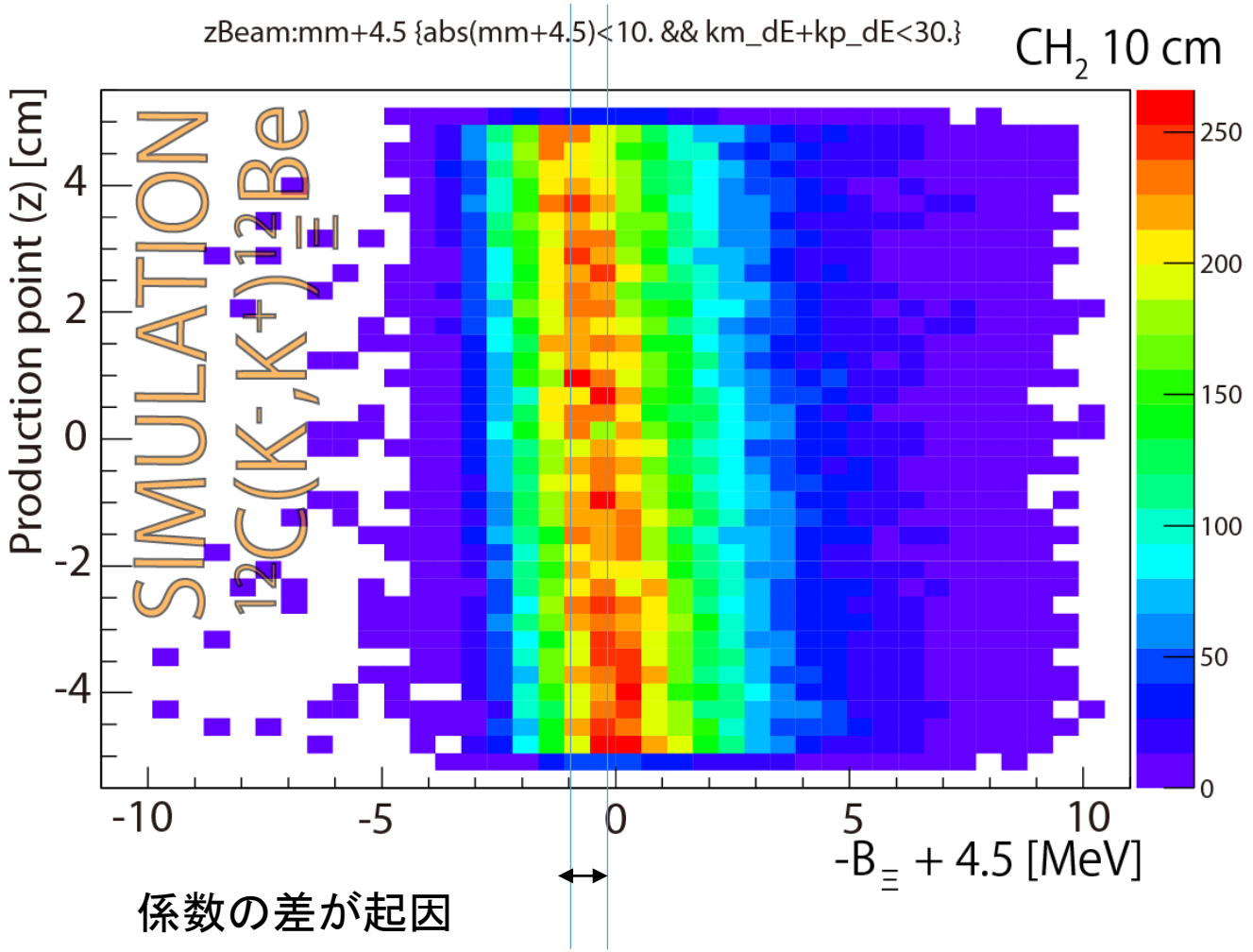
Missing mass vs. Energy loss in the target (9.3 g/cm^2 CH_2)



Missing mass vs. Energy loss in the target (4.65 g/cm^2 CH_2)



$-B_{\Xi}$ vs. z


zBeam:mm+4.5 {abs(mm+4.5)<10. && km_dE+kp_dE<30.}
CH2 10 cm
SIMULATION
12C(K-,K+)12BeΞ
Production point (z) [cm]
4
2
0
-2
-4
-10
-5
0
5
10
-BΞ + 4.5 [MeV]
250
200
150
100
50
0
係数の差が起因

入口で生成

→散乱粒子のみ運動量損失

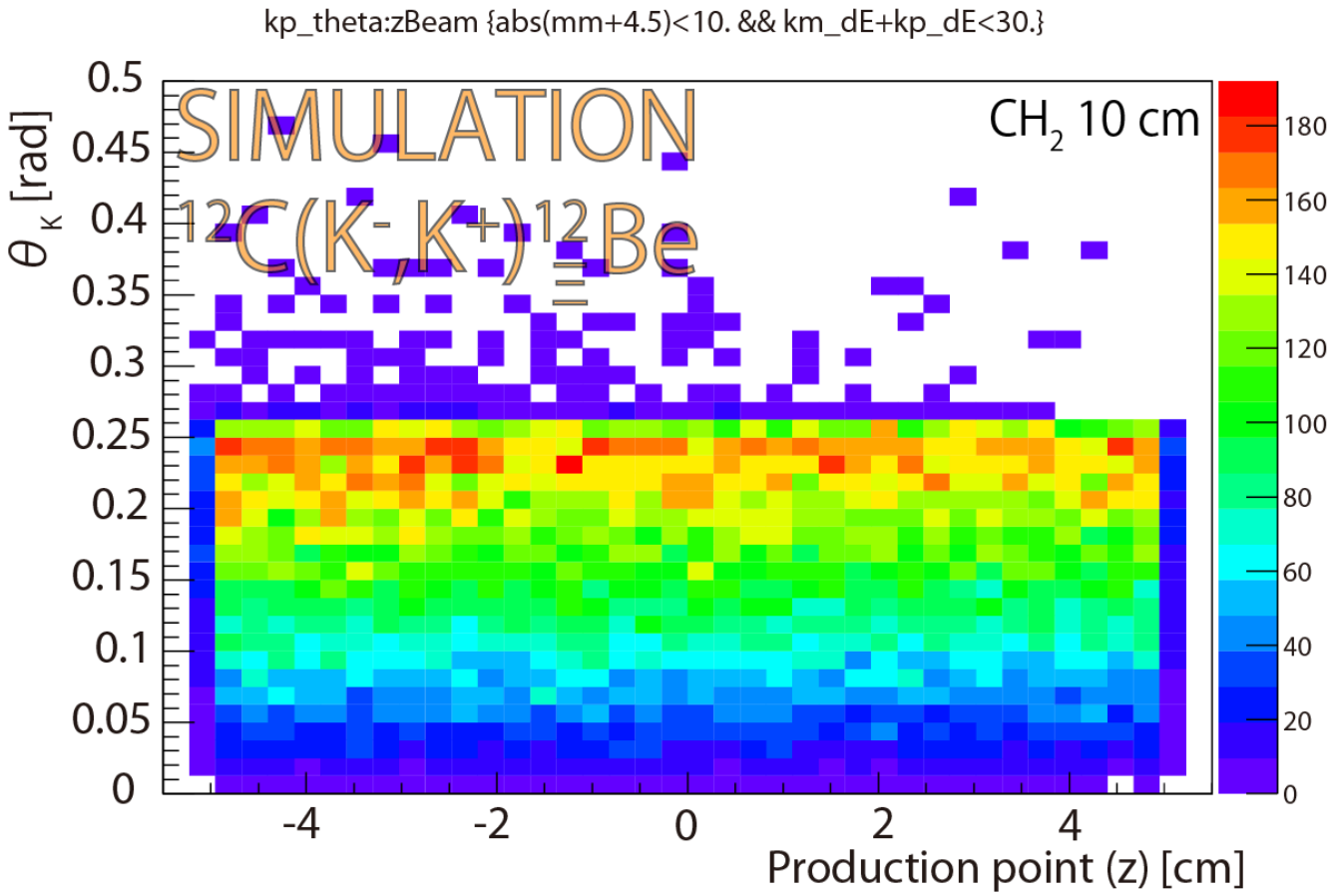
ex.) 0.85 * 20 = 17.0 MeV

出口で生成

→入射粒子のみ運動量損失

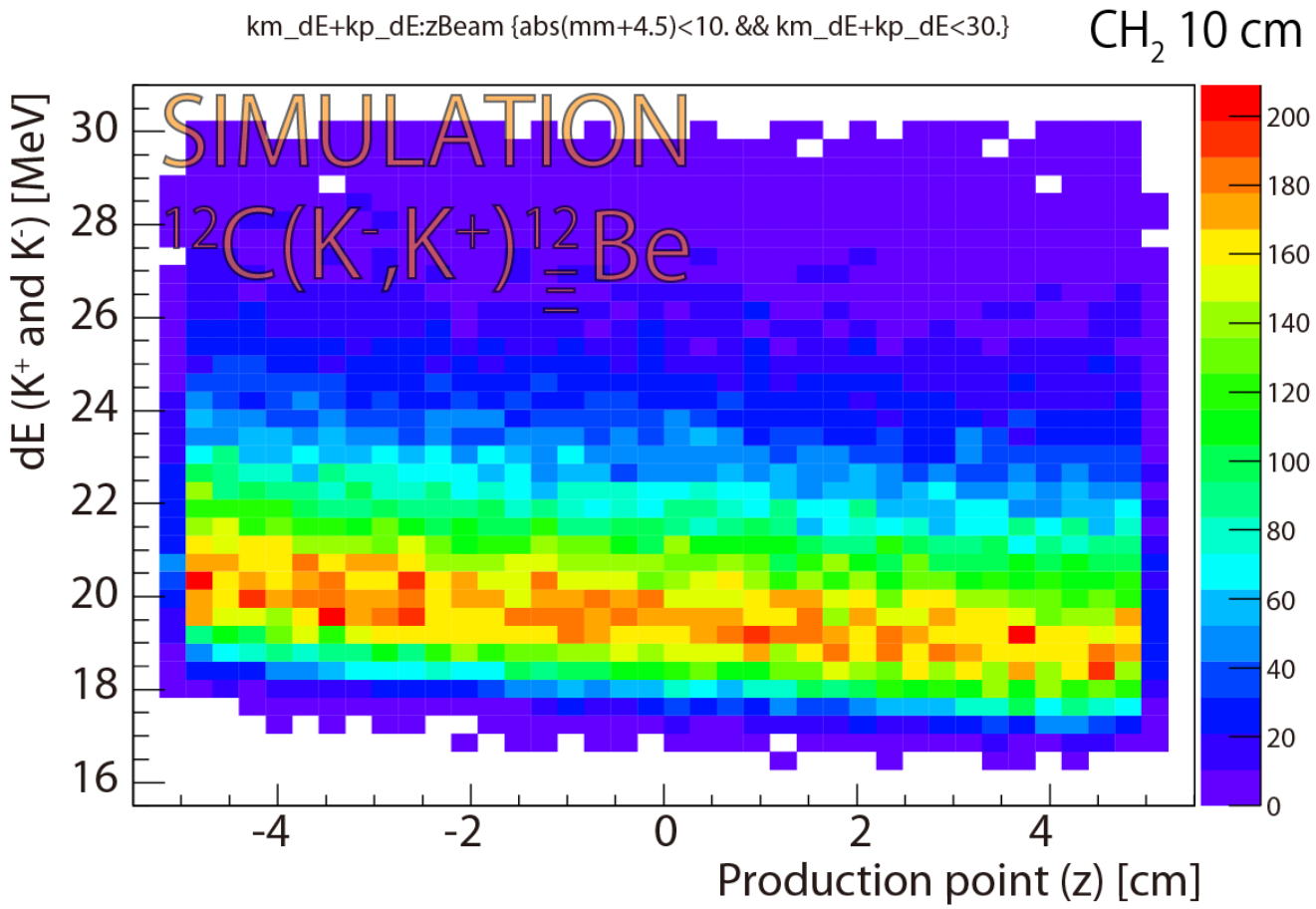
Ex.) 0.93 * 19 = 17.7 MeV

z vs. ϑ_K



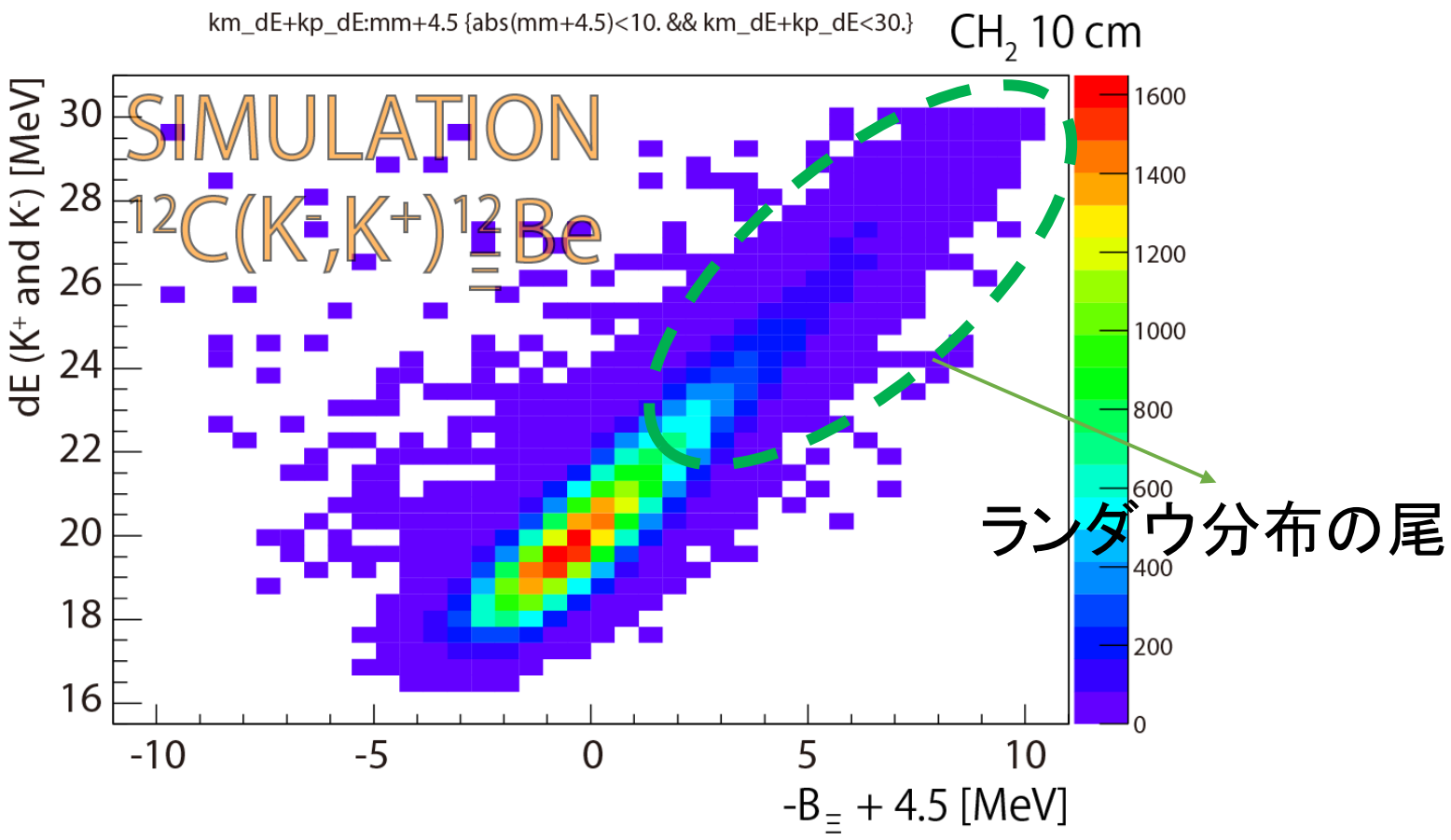
zが小さい程ボケる (多重散乱の効果)

z vs. dE



Zが小さい大きい (多重散乱の効果でpath lengthが伸びる)

$-B_{\Xi}$ vs. dE


km_dE+kp_dE:mm+4.5 {abs(mm+4.5)<10. && km_dE+kp_dE<30.}
CH2 10 cm
SIMULATION
12C(K-,K+)12ΞBe
dE (K+ and K-) [MeV]
30
28
26
24
22
20
18
16
-10
-5
0
5
10
-BΞ + 4.5 [MeV]
1600
1400
1200
1000
800
600
400
200
0
ランダウ分布の尾

ミッシングマスに対する各項の寄与

p:
p_{K-}: 0.64702 * 0.001 * p_{K-} = 1.16464 MeV
p_{K+}: -0.585224 * 0.0005 * p_{K+} = -0.376266 MeV
theta_{K}: -174.443 * 0.003 = -0.523328 MeV
mt/mh=0.709892

Li7:
p_{K-}: 0.901301 * 0.001 * p_{K-} = 1.62234 MeV
p_{K+}: -0.832483 * 0.0005 * p_{K+} = -0.569078 MeV
theta_{K}: -61.0734 * 0.003 = -0.18322 MeV
mt/mh=0.943207

B10:
p_{K-}: 0.91983 * 0.001 * p_{K-} = 1.65569 MeV
p_{K+}: -0.849297 * 0.0005 * p_{K+} = -0.584822 MeV
theta_{K}: -43.6951 * 0.003 = -0.131085 MeV
mt/mh=0.959847

C12:
p_{K-}: 0.926545 * 0.001 * p_{K-} = 1.66778 MeV
p_{K+}: -0.854374 * 0.0005 * p_{K+} = -0.587025 MeV
theta_{K}: -36.6518 * 0.003 = -0.109955 MeV
mt/mh=0.965867

hyperdragon3: /home/dragon/POSI2/analysis/root/mmreso_contribution/
Toshi Gogami , 24July2014
After bug fixed in the calculations.

Pedestals for Cerenkov detector

Run number		Mean	RMS	Remarks
37	1-up	87.49	0.536	[Day 1]-->
	1-down	70.07	0.3479	
	2-up	107.5	0.9192	
	2-down	79.04	0.2805	
51	1-up	94.51	0.5503	[Day 2]-->
	1-down	57.58	0.5871	
	2-up	96.92	0.7061	
	2-down	77.98	0.5189	
72	1-up	93.56	0.8893	
	1-down	56.83	2.088	(w/ cut: 0.6511)
	2-up	95.9	0.7531	
	2-down	76.92	0.6785	
102	1-up	93.07	1.229	(two peaks)
	1-up	57.65	3.289	
	2-up	95.59	1.319	
	2-down	77	0.9512	
103	1-up	93.61	0.5185	
	1-down	56.08	0.4685	
	2-up	96.07	0.9434	
	2-down	76.77	0.842	

Missing mass resolutions vs. Target thickness