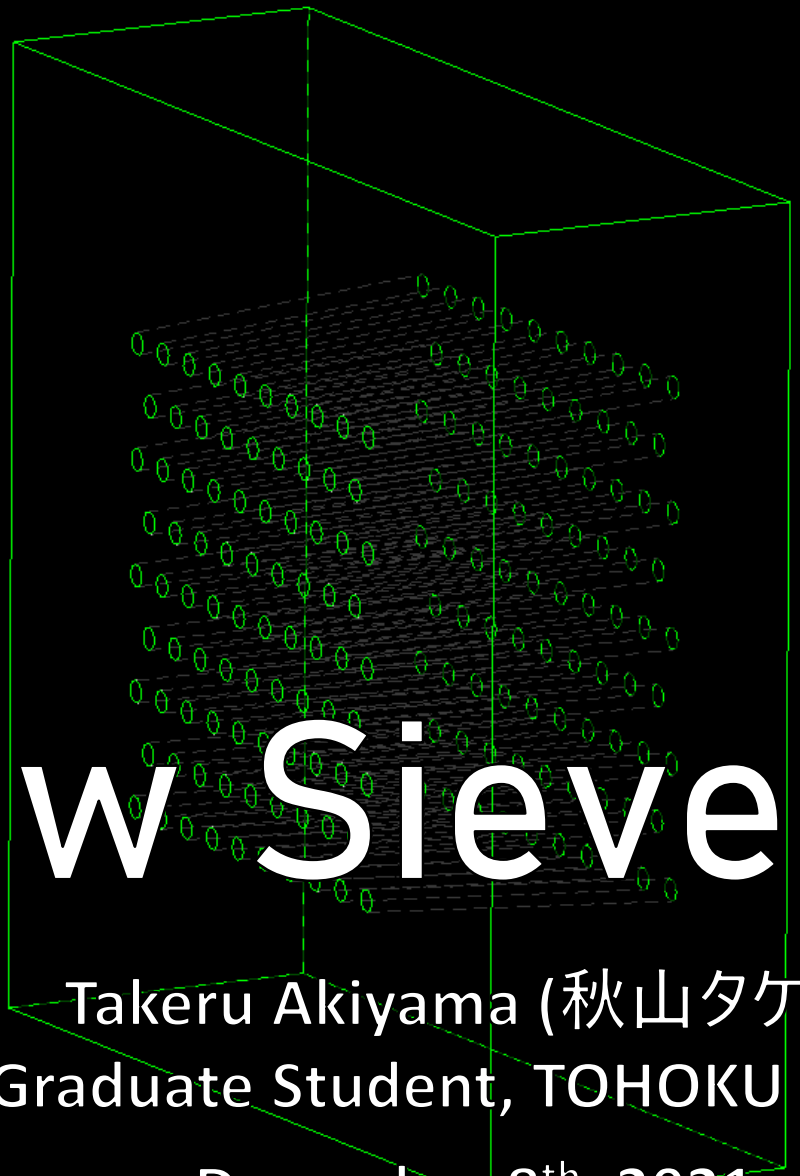

New Sieve Slit

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Graduate Student, TOHOKU UNIV.

December 8th, 2021

Today's Contents

- ◆Introduction
  - About Sieve Slit
- ◆Rough Design (basic idea)
  - Thickness, Hole size, spacing, etc…
  - 3D CAD model
- ◆Simulation Study by Geant4 (PCS+HKS horizontal)
  - Hole Image of new Sieve Slit
- ◆Future Tasks

Introduction

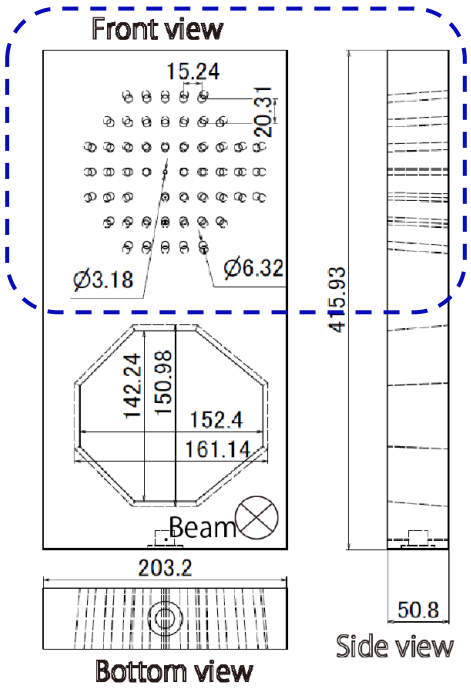
About Sieve Slit

Introduction

Sieve Slit: Metal Plate with a lot of holes,

used for angular calibration

Ref. T.Gogami Doctoral Thesis



- Mounted just behind of target
- Specify the position of particles at the plane
- Angular calibration through optimization of hole pattern image

Sieve Slit: Metal Plate with a lot of holes,

used for angular calibration

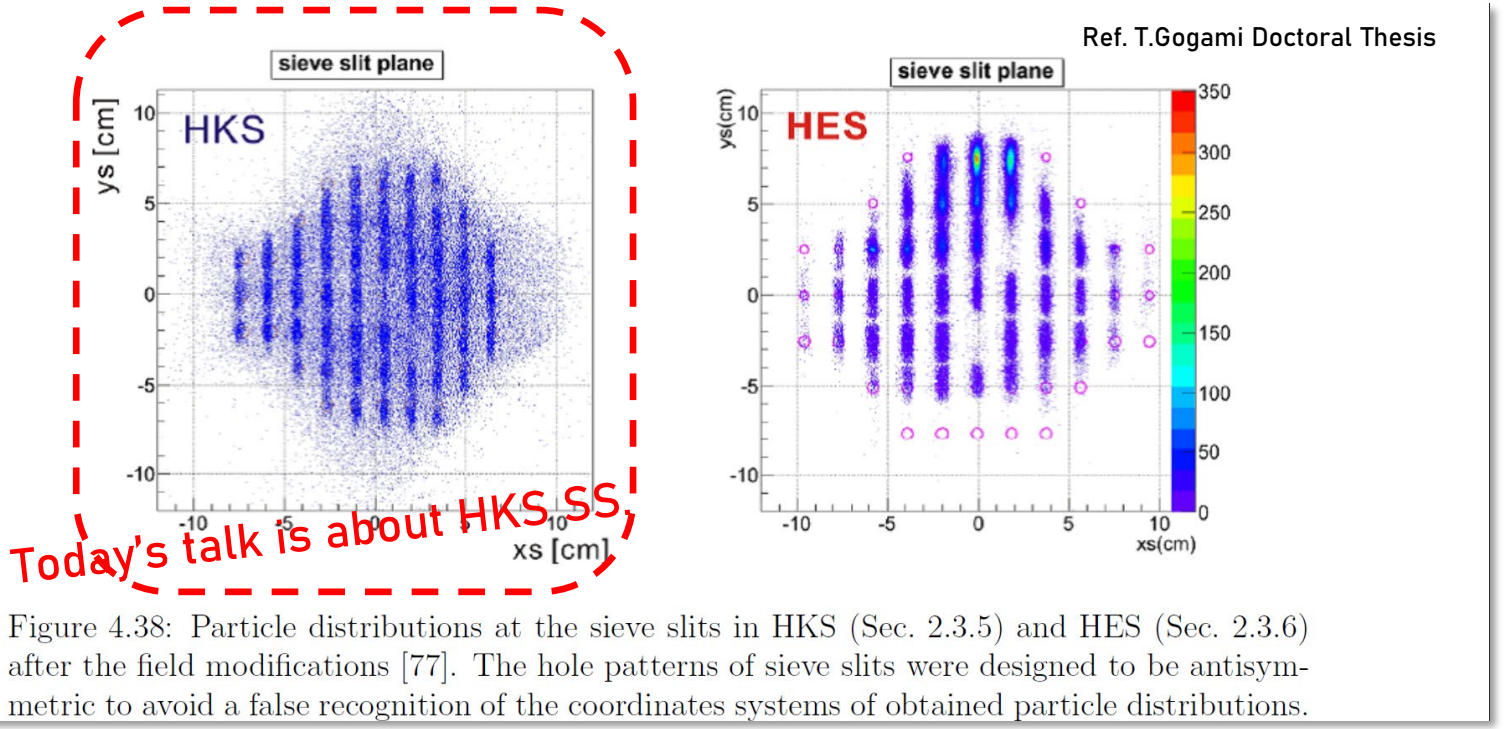


Figure 4.38: Particle distributions at the sieve slits in HKS (Sec. 2.3.5) and HES (Sec. 2.3.6) after the field modifications [77]. The hole patterns of sieve slits were designed to be antisymmetric to avoid a false recognition of the coordinates systems of obtained particle distributions.

- Mounted just behind of target
- Specify the position of particles at the plane
- Angular calibration through optimization of hole pattern image

Rough Design

Thickness, Hole size and spacing, etc…

3D CAD model

Rough Design

Requirement & Design Plan

- Thickness: 50.8 mm (same as E05-115)
- Hole tilt:

  Angle viewed from target (Z = 0)

  From target to SS: 60 cm

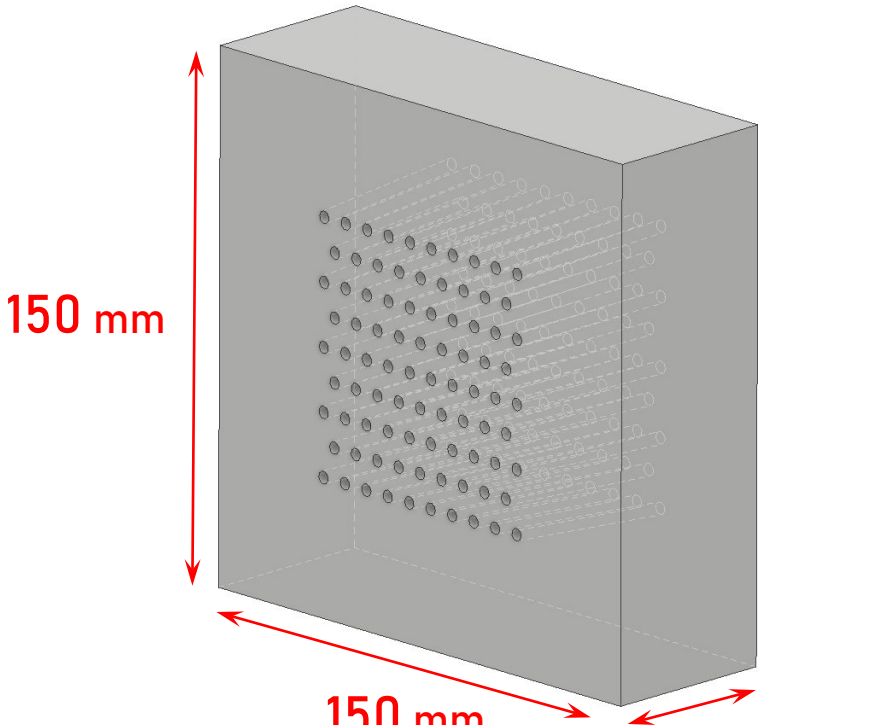
  (150 cm @E05-115)
- Hole size: Φ = 3.5 mm at least

  to keep acceptance for Z = ± 10 cm
- Hole spacing: 8 mm for X, 9 mm for Y

  (Angl. Resolution of HKS ΔX' = 1.24 mrad, ΔY' = 2.96 mrad)

  shift half a cell every other row

3D CAD Model



~ 16 kg

Rough Design

Requirement & Design Plan

- **Thickness: 50.8 mm** (same as E05-115)
- Hole tilt:
  - Angle viewed from target (Z = 0)
  - From target to SS: 60 cm
    (150 cm @E05-115)
- Hole size: Φ = 3.5 mm at least
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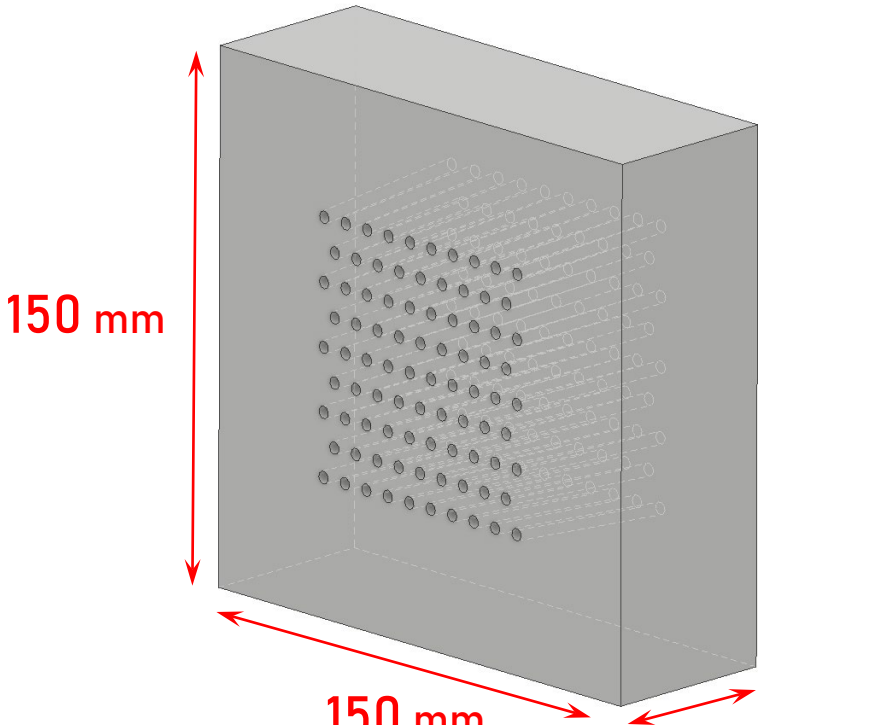
3D CAD Model



~ 16 kg

Rough Design

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- Thickness: 50.8 mm (same as E05-115)
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  Angle viewed from target (Z = 0)

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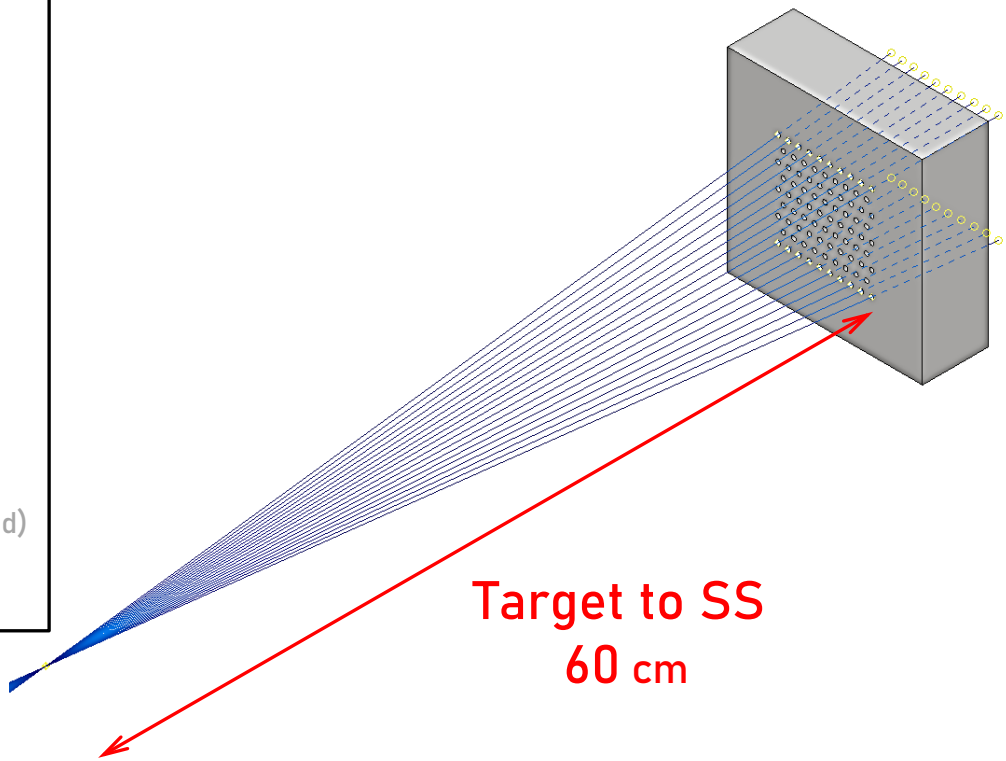
3D CAD Model



Rough Design

Requirement & Design Plan

- Thickness: 50.8 mm (same as E05-115)
- Hole tilt:

  Angle viewed from target (Z = 0)

  From target to SS: 60 cm

  (150 cm @E05-115)

- **Hole size: Φ = 3.5 mm at least**

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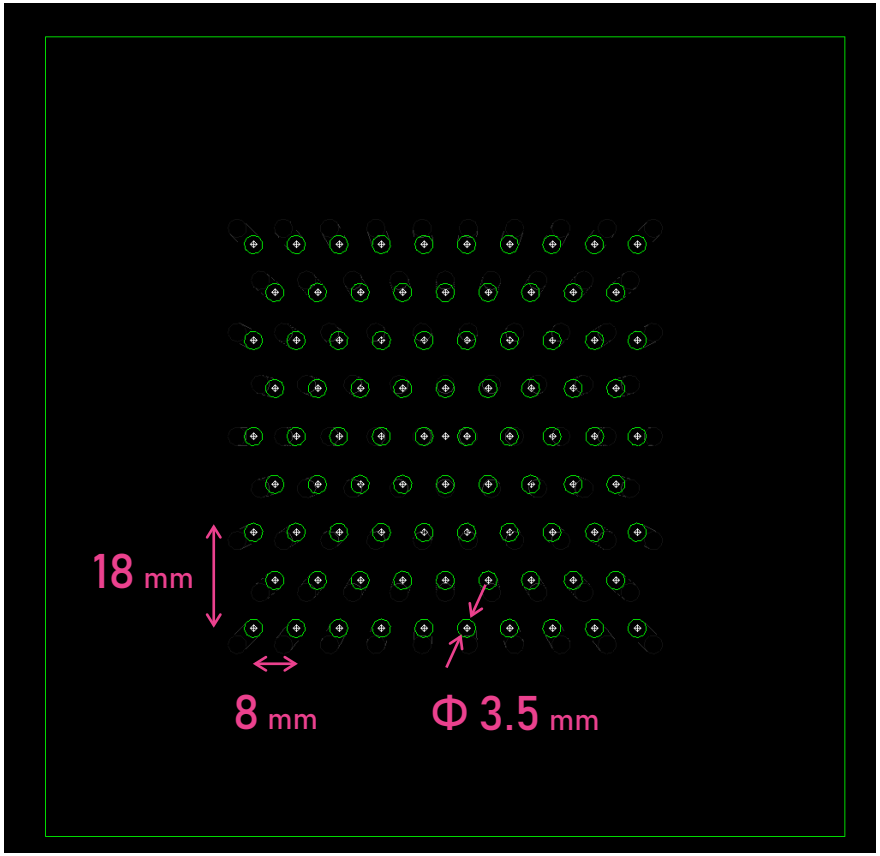
  (Angl. Resolution of HKS ΔX' = 1.24 mrad, ΔY' = 2.96 mrad)

  shift half a cell every other row

3D CAD Model



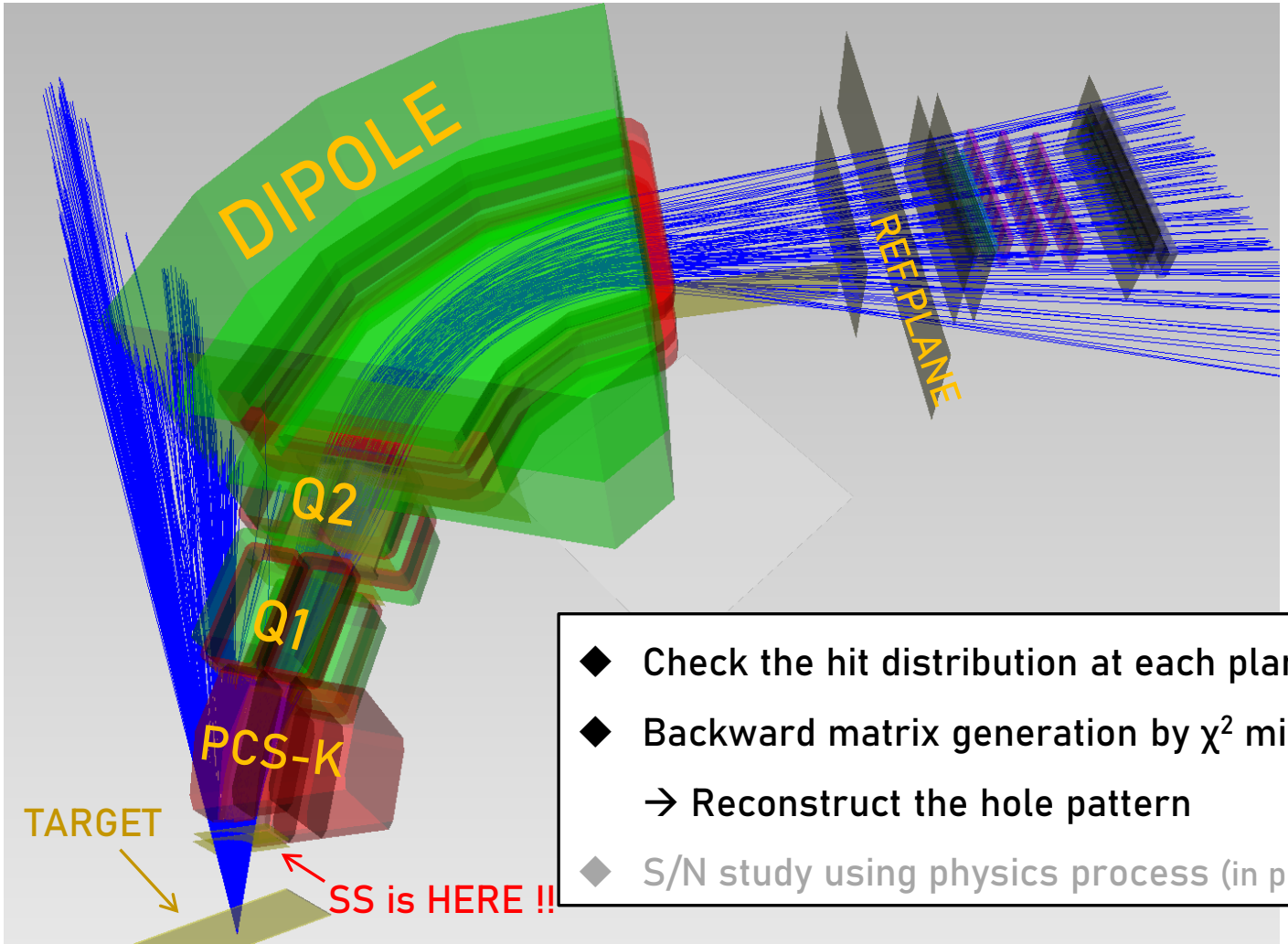
Simulation Study by Geant4

Setup

Hit Distribution at SS Plane

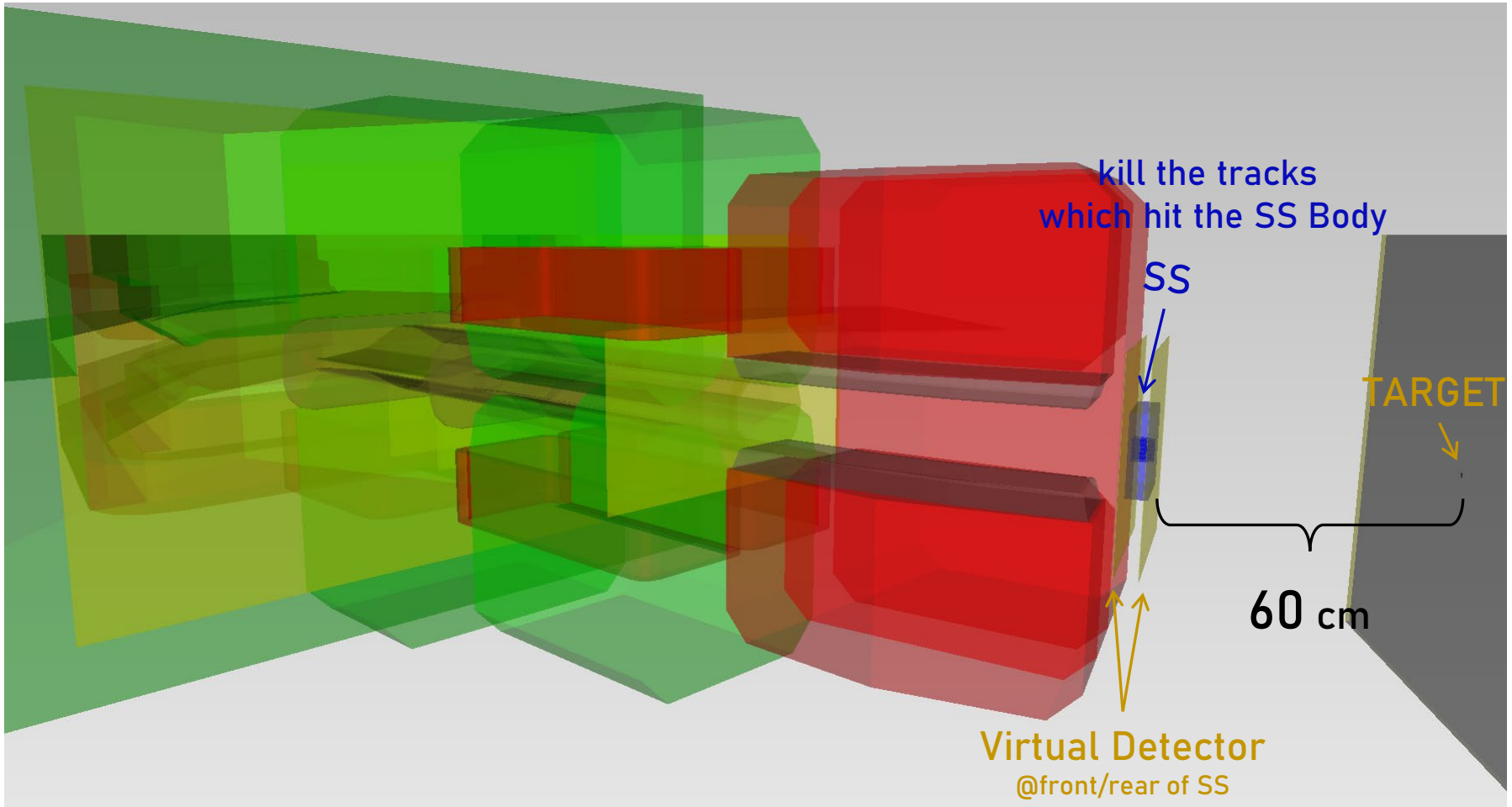
Reconstructed Image of Hole Pattern

PCS+HKS (horizontal) Setup



- Check the hit distribution at each plane
- Backward matrix generation by χ^2 minimization
  → Reconstruct the hole pattern
- S/N study using physics process (in preparation)

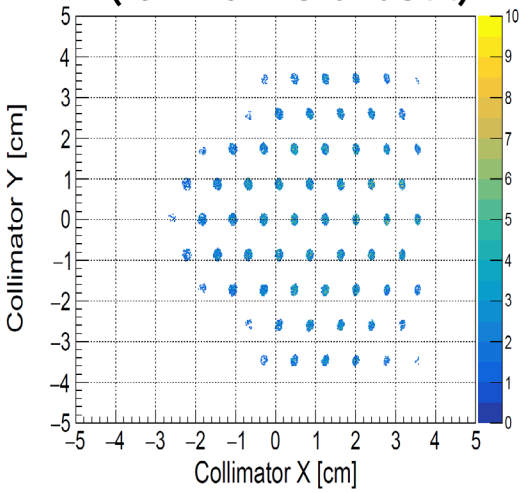
PCS+HKS (horizontal) Setup



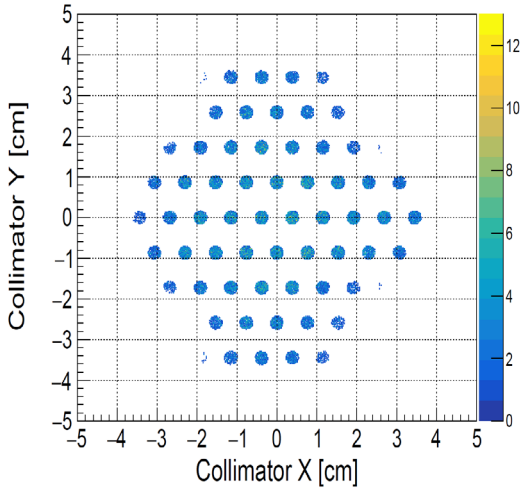
TRUE Hit Pattern @Front of SS

Φ3.5mm hole
No physics process included, Tracks killed at SS body
Required a hit to TOF2X

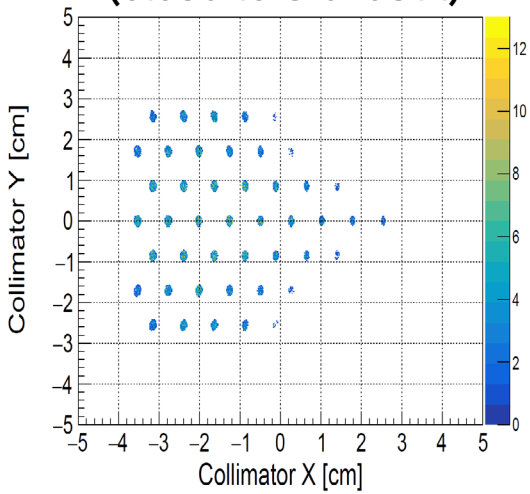
Z = -10 cm
(far from SieveSlit)



Z = 0



Z = +10 cm
(close to SieveSlit)

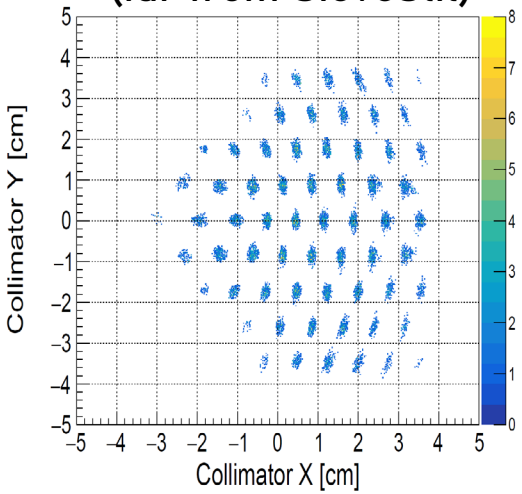


◆ Acceptance shape shifted along X direction for Z ≠ 0

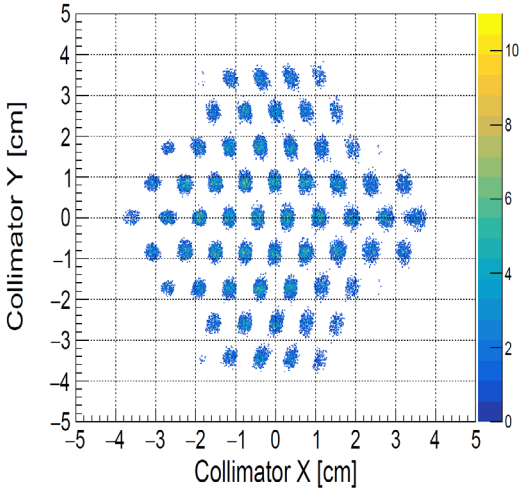
Reconstructed Hit Pattern @Front of SS

Φ3.5mm hole
No physics process included, Tracks killed at SS body
Required a hit to TOF2X

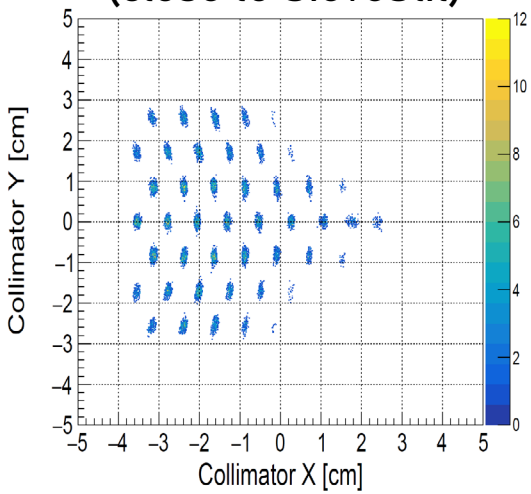
Z = -10 cm
(far from SieveSlit)



Z = 0



Z = +10 cm
(close to SieveSlit)



- Acceptance shape shifted along X direction for Z ≠ 0
- Hole pattern can be identified well

Future Tasks

Future Tasks

◆The angle covered by a single hole

Target to SS = 60 cm, Hole Size = 3.5 mm ⇛ ~ 5.8 mrad/hole

c.f.) at E05-115 Experiment,
Target to SS = 150 cm, Hole Size = 6 mm ⇛ ~ 4.0 mrad/hole

Is it possible to calibrate the angle with such larger holes ?

or, prepare several sieve slits (with smaller holes) for different Z ??

→ Estimation of achievable resolution by the matrix tuning is necessary

◆Effect of physics interaction with the SS

S/N ratio, deterioration due to hole edges

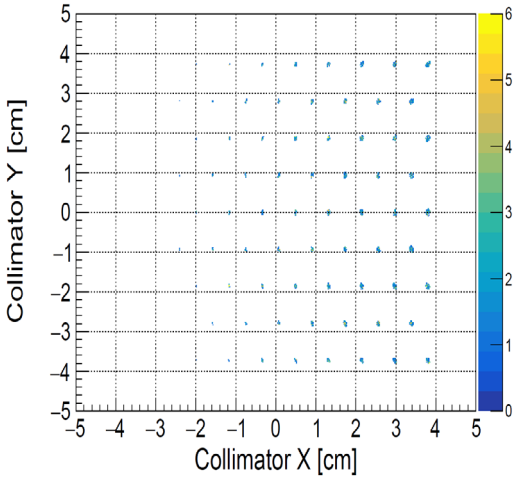
◆Similar study for HES-side

Hit Pattern @Rear of SS

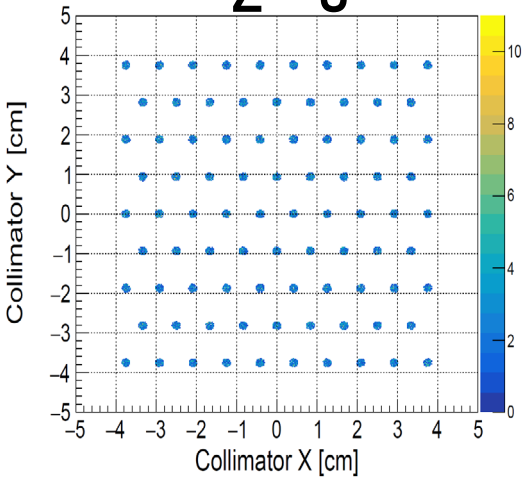
Tracks which hit the SS are killed.

ϕ2mm hole = cannot pass through the SS

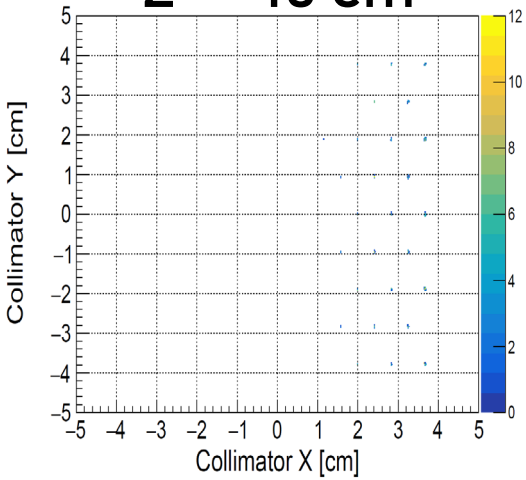
Z = -10 cm



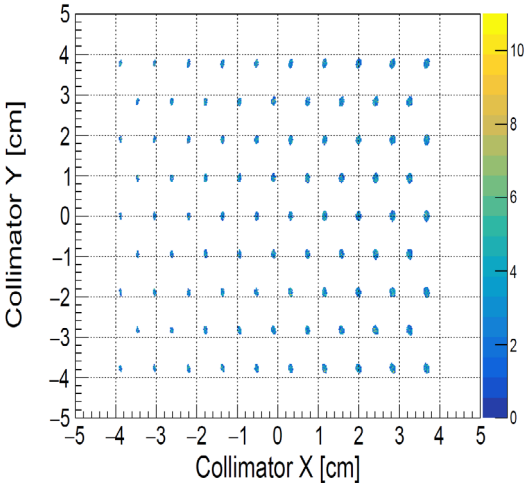
Z = 0

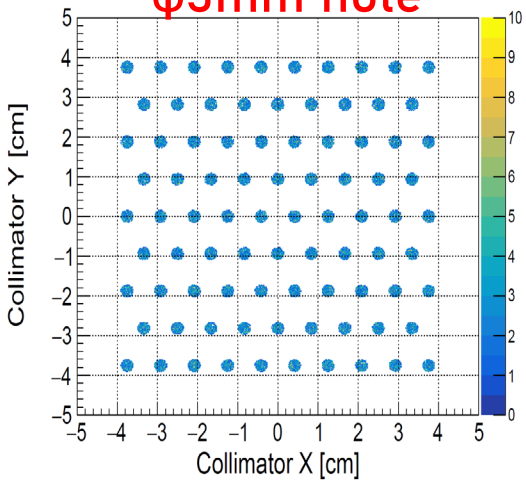


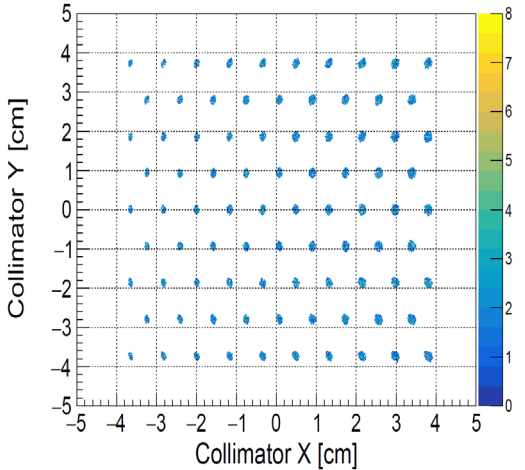
Z = +10 cm



ϕ3mm hole





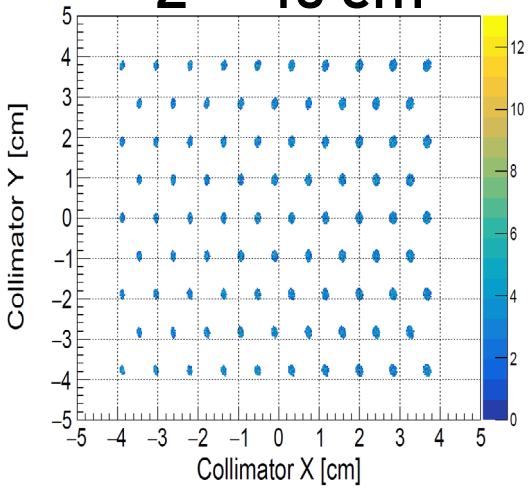


Hit Pattern @Rear of SS

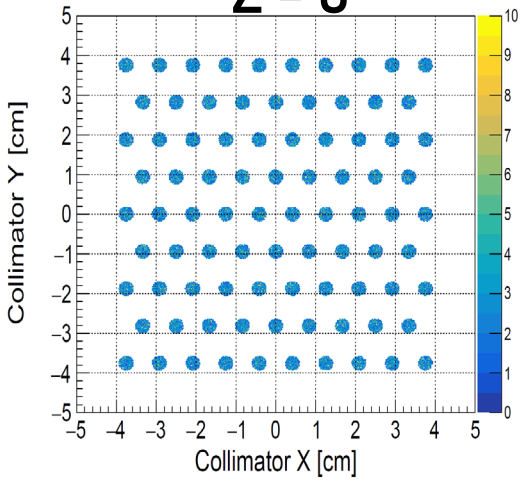
Tracks which hit the SS are killed.

ϕ3.5mm hole = seems reasonable hole size

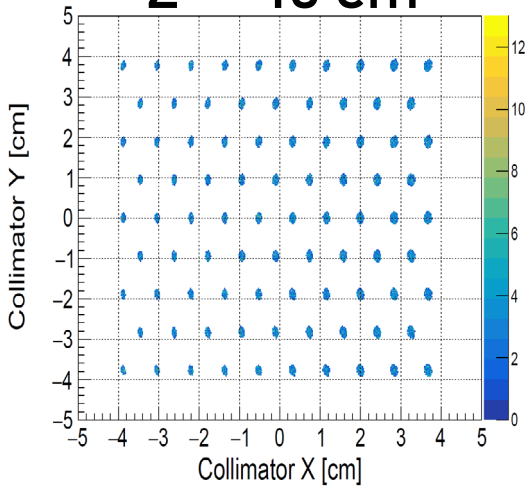
Z = -10 cm



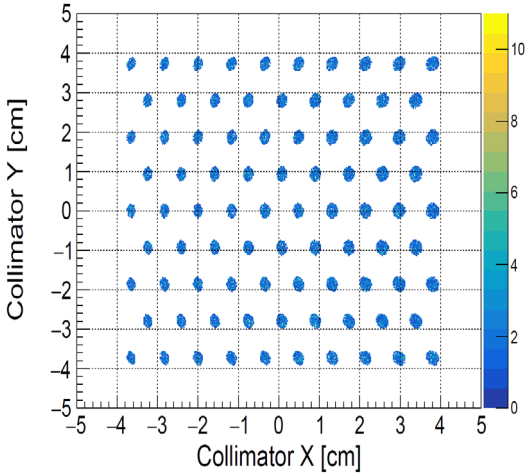
Z = 0

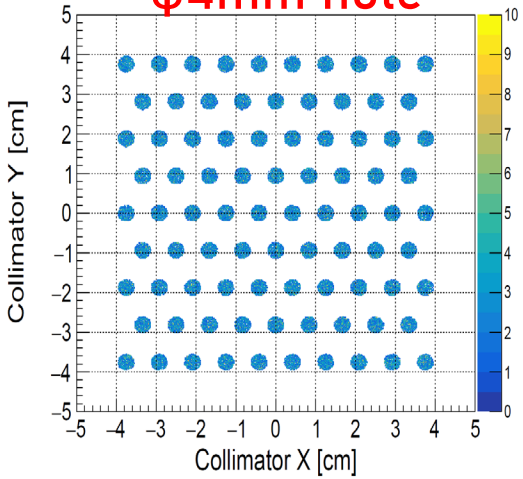


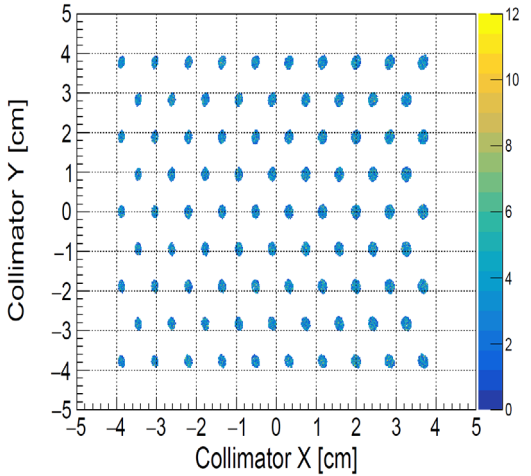
Z = +10 cm



ϕ4mm hole





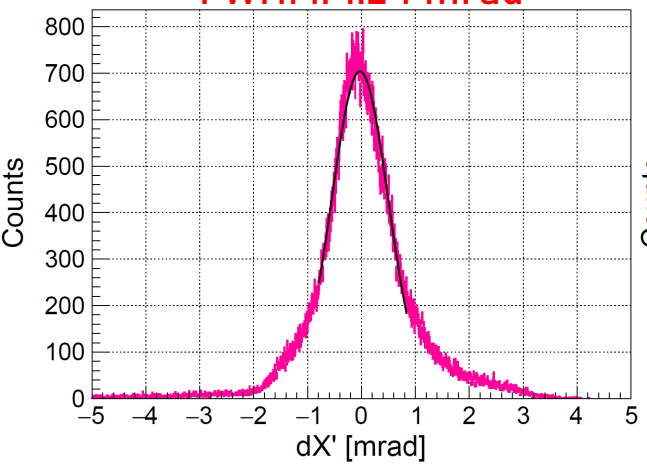


Angular Resolution @Target

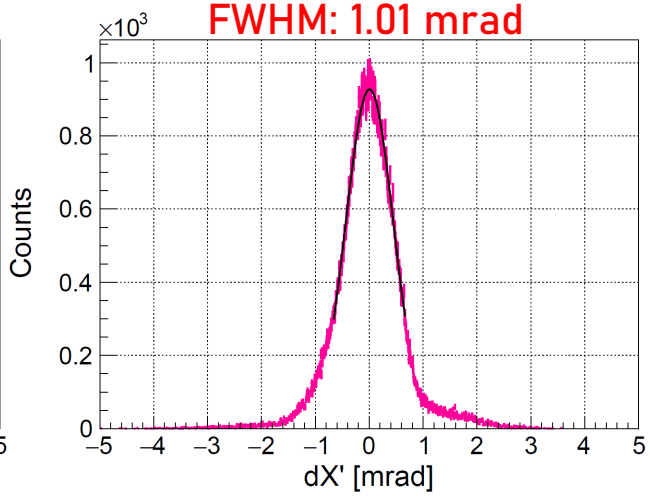
Sieve Slit removed, Particles emitted at Z=0

Order of Matrix: 3 4 5

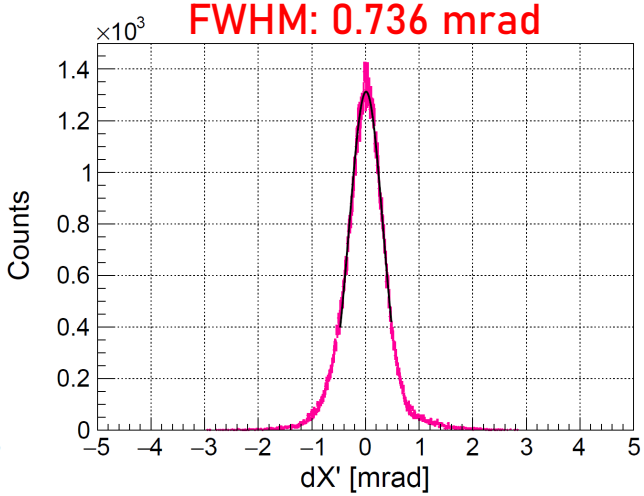
FWHM: 1.24 mrad



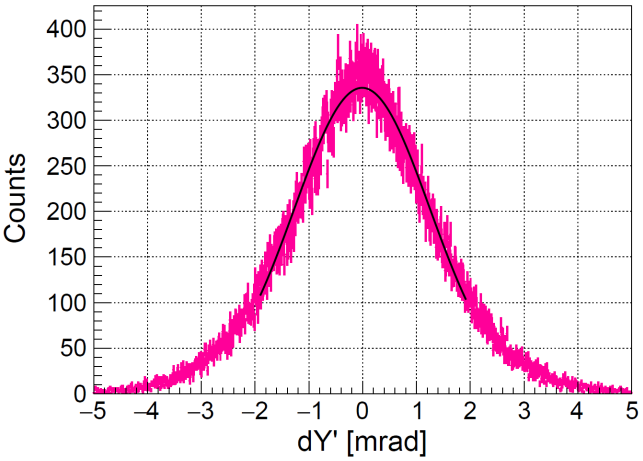
FWHM: 1.01 mrad



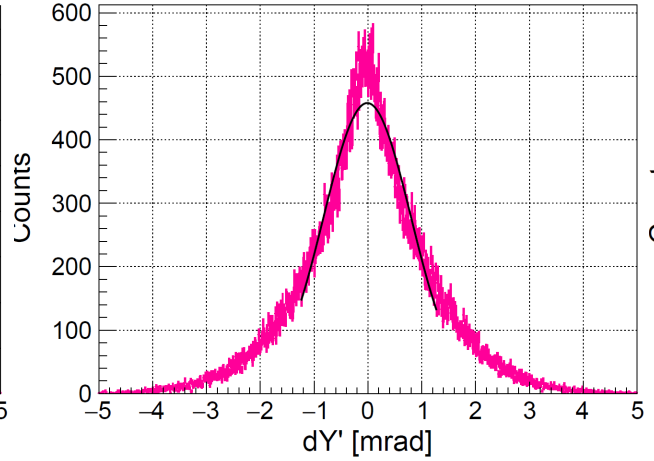
FWHM: 0.736 mrad



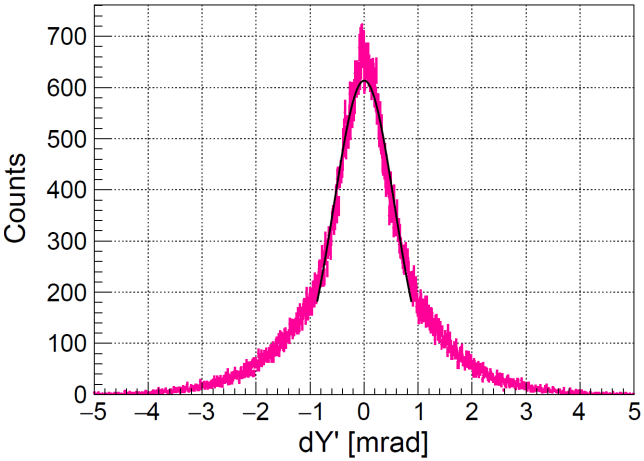
FWHM: 2.96 mrad



FWHM: 1.92 mrad



FWHM: 1.32 mrad

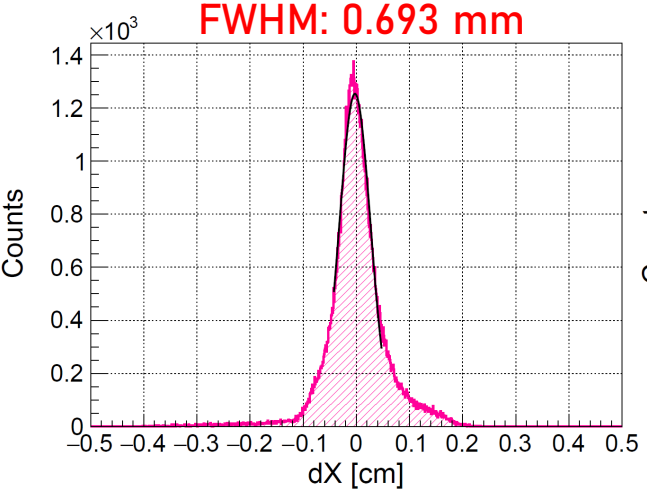


Position Resolution @front of SS

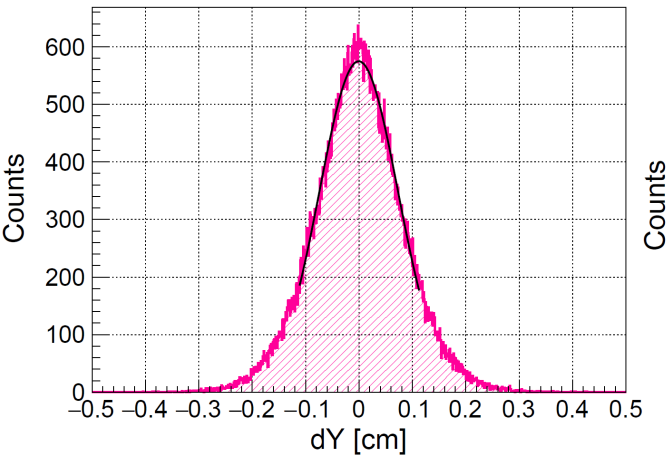
Sieve Slit removed, Particles emitted at Z=0

Order of Matrix: 3

FWHM: 0.693 mm

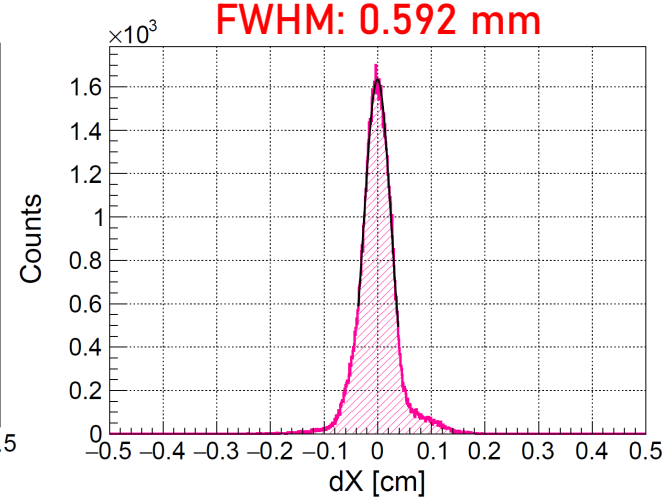


FWHM: 1.73 mm

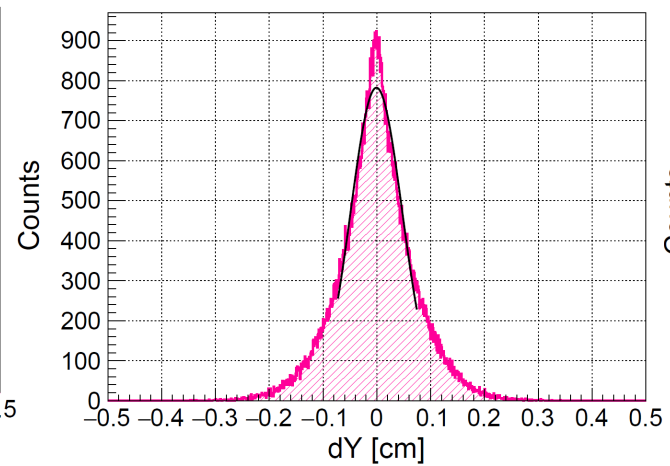


4

FWHM: 0.592 mm

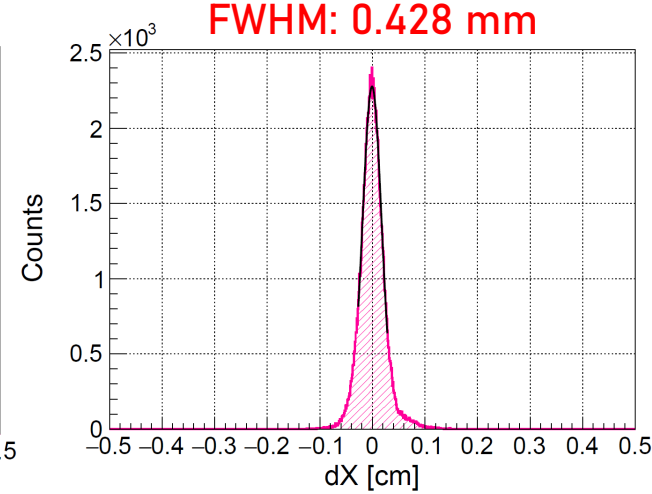


FWHM: 1.13 mm

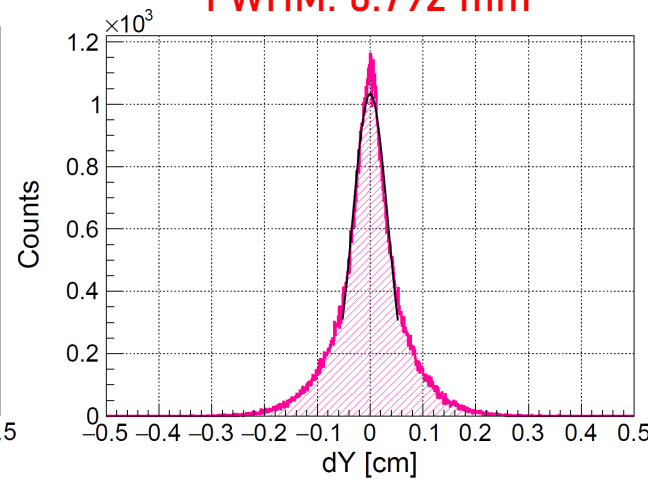


5

FWHM: 0.428 mm



FWHM: 0.792 mm

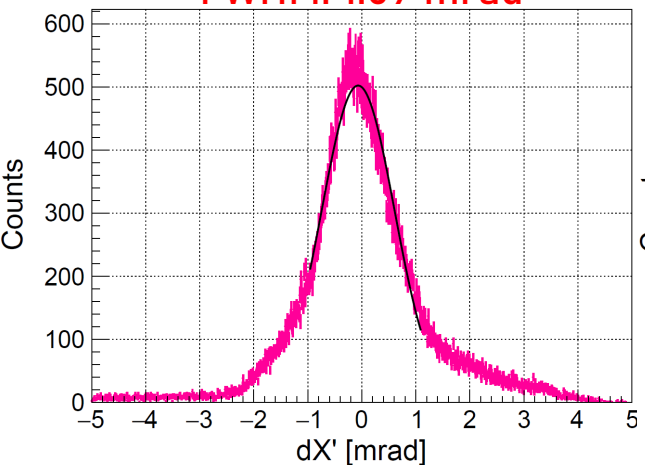


Angular Resolution @Target

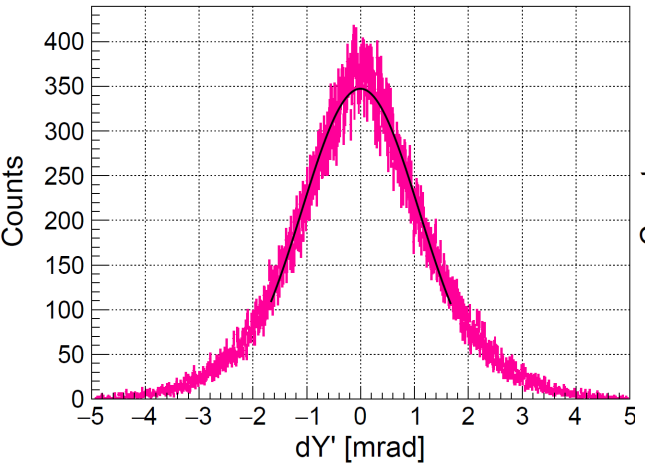
Sieve Slit removed, Particles emitted from the point, Order of Matrix = 3

Z = -10 cm

FWHM: 1.59 mrad

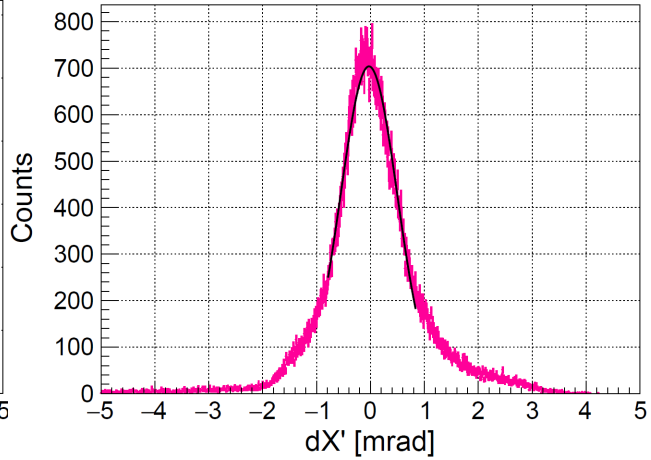


FWHM: 2.57 mrad

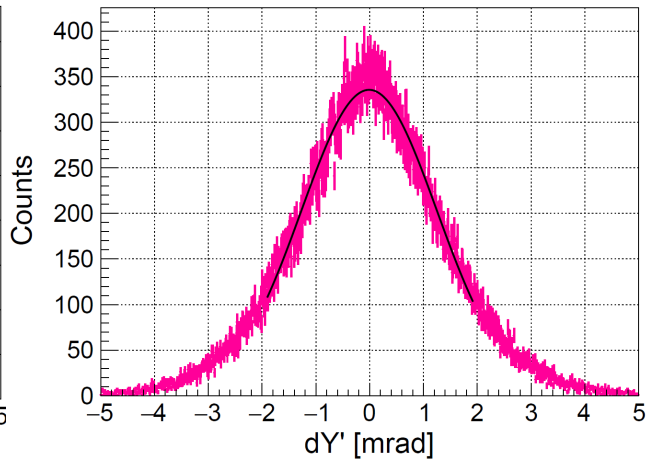


Z = 0

FWHM: 1.24 mrad

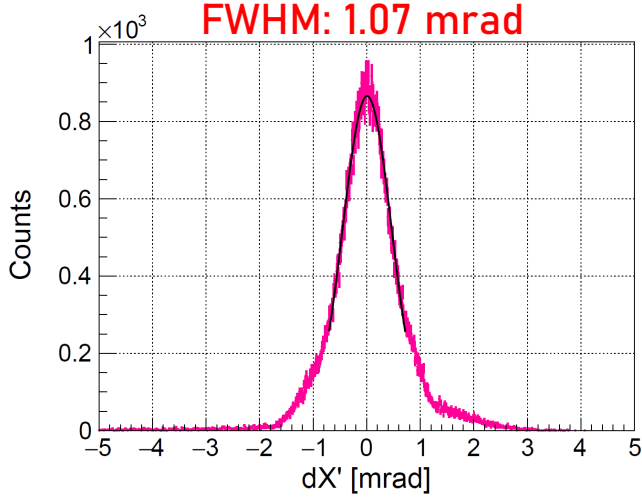


FWHM: 2.96 mrad

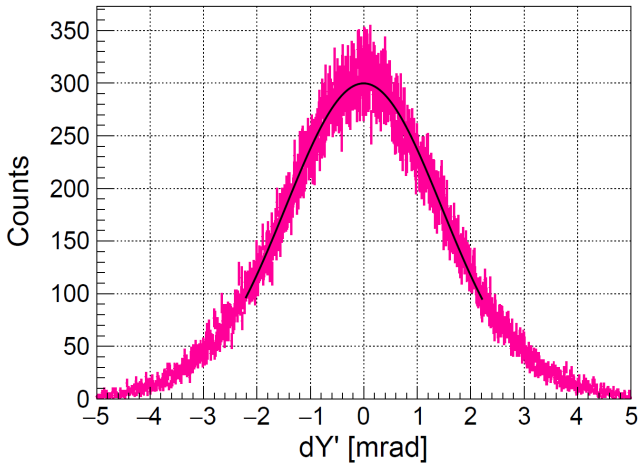


Z = +10 cm

FWHM: 1.07 mrad



FWHM: 3.44 mrad

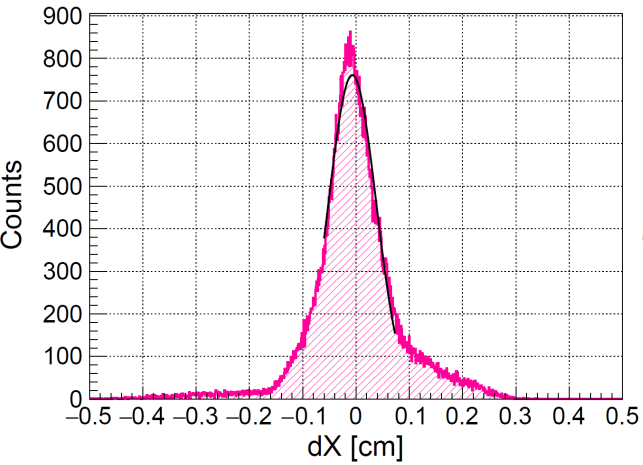


Position Resolution @front of SS

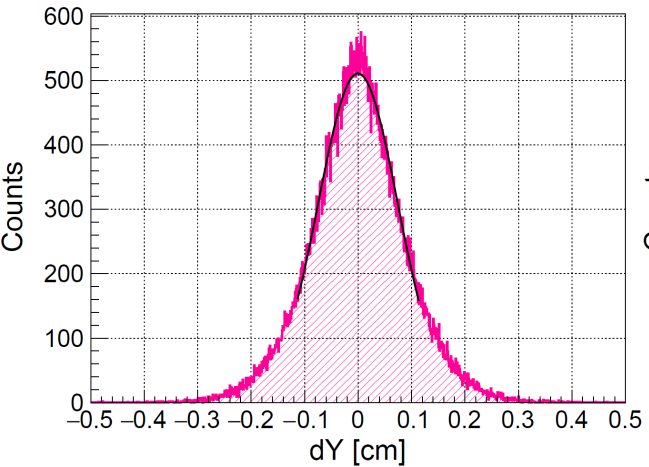
Sieve Slit removed, Particles emitted from the point, Order of Matrix = 3

Z = -10 cm

FWHM: 1.05 mm

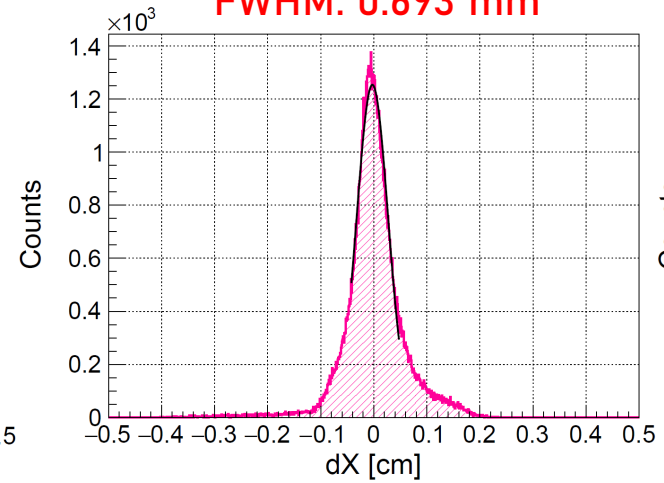


FWHM: 1.75 mm

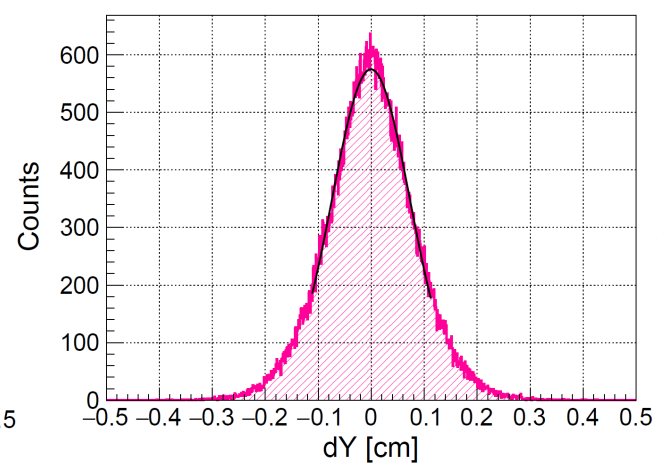


Z = 0

FWHM: 0.693 mm

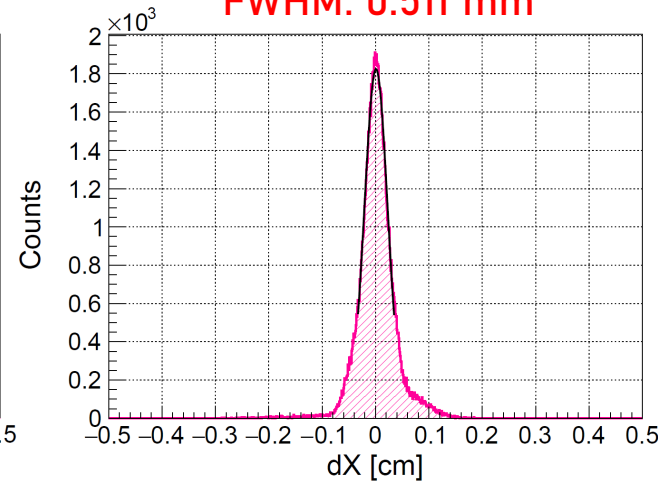


FWHM: 1.73 mm

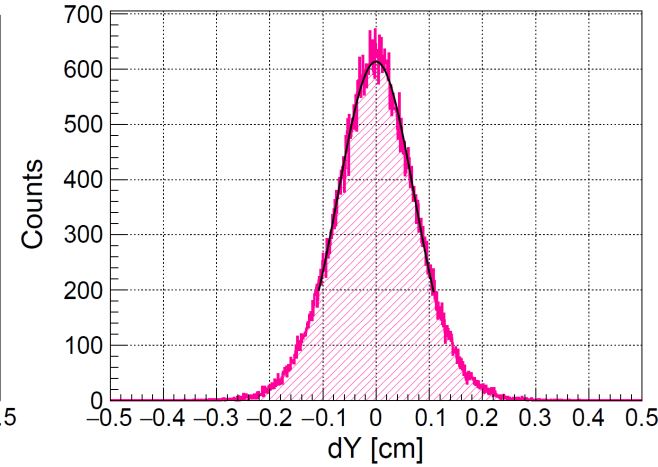


Z = +10 cm

FWHM: 0.511 mm



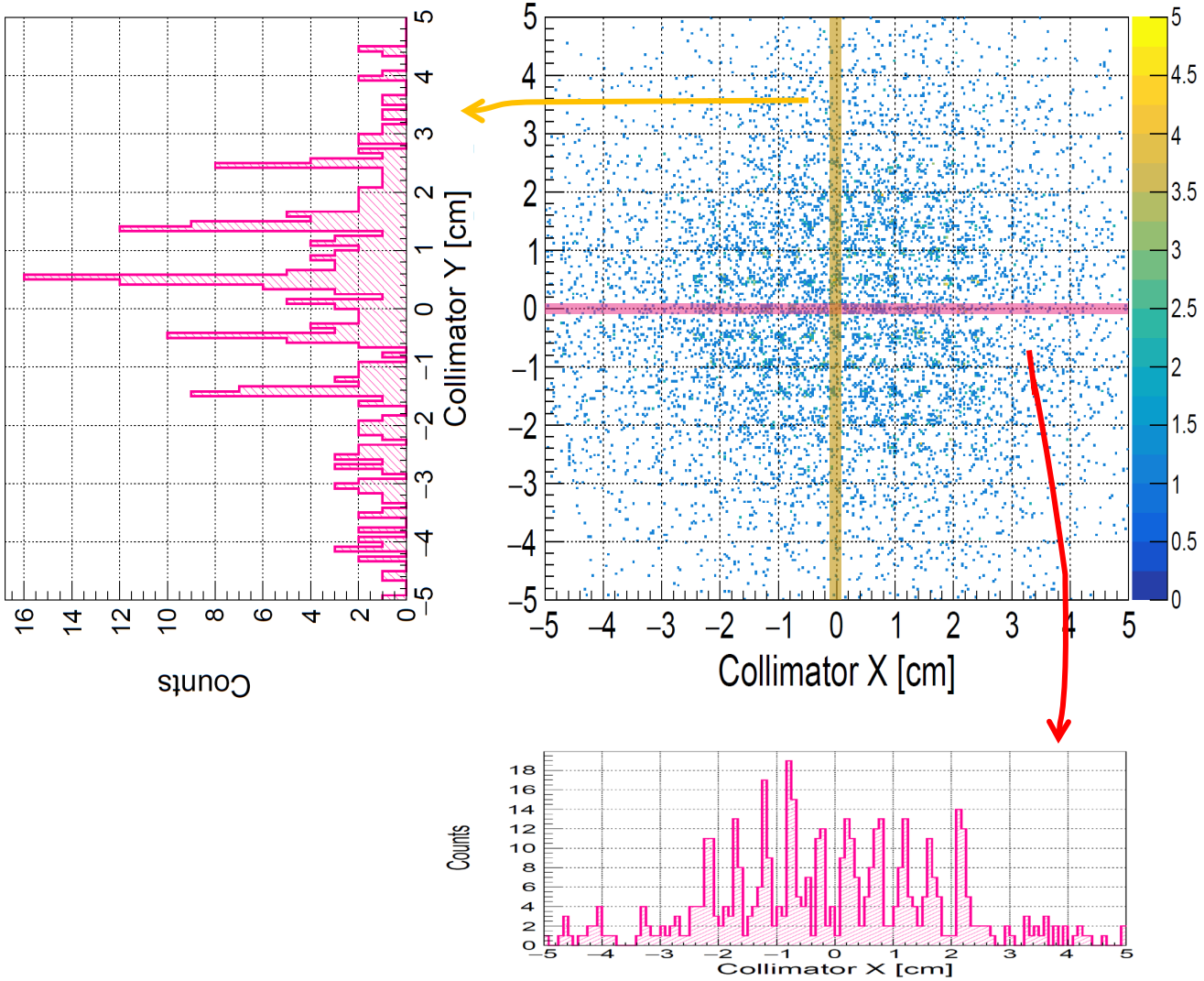
FWHM: 1.69 mm



Summary of Resolution (FWHM)

Z [cm]	order	δX' [mrad]	δY' [mrad]	δX [mm]	δY [mm]
0	6	0.612	1.32	0.368	0.775
0	5	0.736	1.32	0.428	0.792
0	4	1.01	1.92	0.592	1.13
0	3	1.24	2.96	0.693	1.73
-10	6	0.657	1.07	0.450	0.743
-10	3	1.59	2.57	1.05	1.75
+10	6	0.619	1.31	0.309	0.656
+10	3	1.07	3.44	0.511	1.69

Blurs from both 2 holes adjacent

→ spacing: ~?? σ separation (4 mm for X, 7 mm for Y)

厚さ: 5.08 cm
穴径: 2 mm
距離(水平方向): 5 mm
運動量: 1.2 ± 0.25 GeV/c