# SAM Rate Simulation for New Designs

## Radiation Meeting

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# Geant 4 Run information

**Beam Parameters**

- Target Position: -105 cm
- Target Material: Pure Lead (11.39 g/$cm^3$)
- Target Thickness: 0.05 cm (0.569 g/$cm^2$)
- Beam Energy: 1.0 GeV
- Beam Current: 70 $\mu$ A
- Raster: 4 mm x 4 mm
- Physics List: FTFP_BERT_HP

**Beamline**

- Collimator
- Septum
- No Magnetic Field Applied
- Al Can Wall thickness: 0.065 inch = 1.651 mm
- SAM Quartz

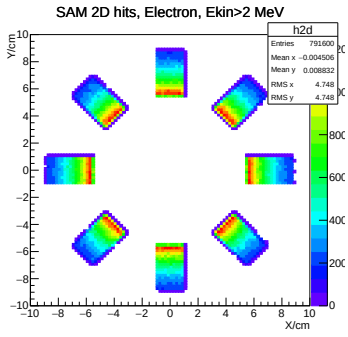
# SAM Designs

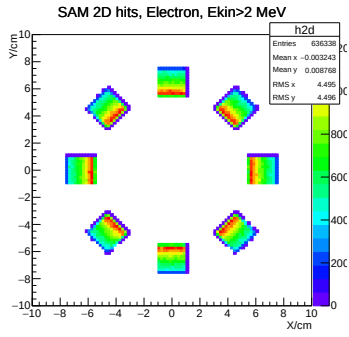
- Actual Hall A SAM dimension 3.3 cm x 2 cm x 1.3 cm, with 45 deg bevel
- Previous simulation: 3 cm x 2 cm x 1.3 cm blocks
- New design: with 45 deg bevel
  - 2.6 cm x 2 cm x 6 mm
  - 1.85 cm x 2 cm x 6 mm
- This work: only the active area, without 45 deg bevel
  - 3.3 cm x 2 cm x 13 mm block
  - 2 cm x 2 cm x 6 mm block
  - 1.25 cm x 2 cm x 6 mm block

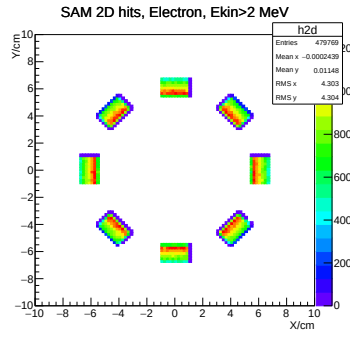
**Note on new designs simulation**

- thickness should not change event rate:
  Rate(2 cm x 2 cm x 6 mm) $\approx$ Rate(2 cm x 2 cm x 1.3 cm)
- In term of rate, 45 deg bevel sees event from larger angle.
- In term of energy resolution, 45 deg devel parts produce lower P.E. (unknown).
- P.E. yield from 45 bevel could be measured from simulation.
- So the effect on the RMS width is unknown.

# Some Plots : )


SAM 2D hits, Electron, Ekin>2 MeV
h2d
Entries 791600
Mean x −0.004506
Mean y 0.008832
RMS x 4.748
RMS y 4.748
Y/cm
X/cm


SAM 2D hits, Electron, Ekin>2 MeV
h2d
Entries 636338
Mean x −0.003243
Mean y 0.008768
RMS x 4.495
RMS y 4.496
Y/cm
X/cm


SAM 2D hits, Electron, Ekin>2 MeV
h2d
Entries 479769
Mean x −0.0002439
Mean y 0.01148
RMS x 4.303
RMS y 4.304
Y/cm
X/cm

# SAM Rate - Position Scan Curve

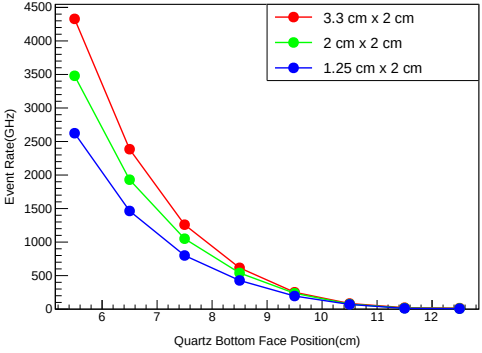



Figure: Linear Scale

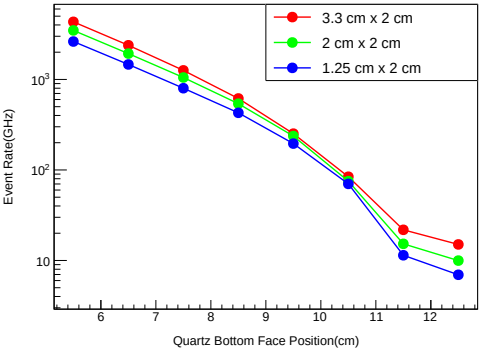



Figure: Log Scale: to see shadowing effect

# SAM Rate - Position Scan

Only electron counts

| Bottom Pos.(cm) | Rate1 (GHz) | Rate2 (GHz) | Rate3 (GHz) |
|---|---|---|---|
| 5.5 | 4329.1 | 3480.0 | 2623.7 |
| 6.5 | 2385.3 | 1930.4 | 1464.2 |
| 7.5 | 1259.6 | 1050.5 | 800.1 |
| 8.5 | 616.3 | 539.9 | 427.9 |
| 9.5 | 251.9 | 236.8 | 195.6 |
| 10.5 | 84.1 | 75.2 | 70.2 |
| 11.5 | 21.8 | 15.3 | 11.4 |
| 12.5 | 15.0 | 10.0 | 7.0 |

Rate 1: Assuming 3.3 cm x 2 cm active area (not realistic)
Rate 2: 2.0 cm x 2 cm active area
Rate 3: 1.25 cm x 2 cm active area

# SAM Width

| Pos.(cm) | 2x2x1.3 (ppm) | 2x2x0.6 (ppm) | 1.25x2x1.3 (ppm) | 1.25x2x0.6 (ppm) |
|---|---|---|---|---|
| 5.5 | 3 | 3 | 4 | 4 |
| 6.5 | 4 | 4 | 5 | 5 |
| 7.5 | 6 | 6 | 7 | 7 |
| 8.5 | 8 | 8 | 9 | 9 |
| 9.5 | 12 | 12 | 13 | 14 |
| 10.5 | 21 | 22 | 22 | 23 |
| 11.5 | 48 | 49 | 55 | 56 |
| 12.5 | 59 | 60 | 70 | 72 |

- for 1.3 cm thickness: resolution 39 %
- for 0.6 cm thickness: resolution 46 %

# Backup: SAM Width from Rate

$$\sigma = \frac{1}{\sqrt{2 \times R \times 2T}},$$

- $R$: is the rate, [sec$^{-1}$]
- The first factor 2: for two helicity windows, L and R
- The second factor 2: for (1+4)-(2+3) quadruplet asymmetry
- $T = 0.0083$ sec: for 120 Hz helicity

Asymmetry degradation with finite energy resolution

$$\sigma' = \sigma \sqrt{1 + \left(\frac{\Delta E}{E}\right)^2}$$

The following slides show asymmetries including finite detector energy resolution