고려대학교 KOREA UNIVERSITY

Hadron & Nuclear Physics Lab

Progress Report, May 01

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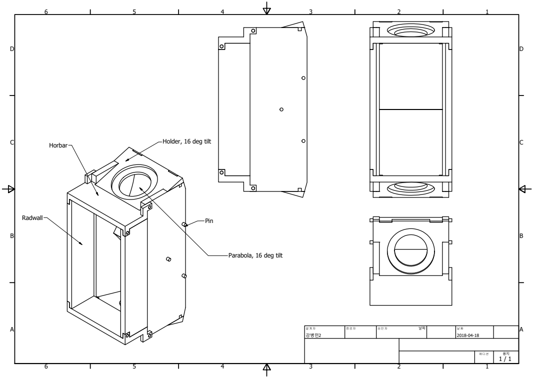
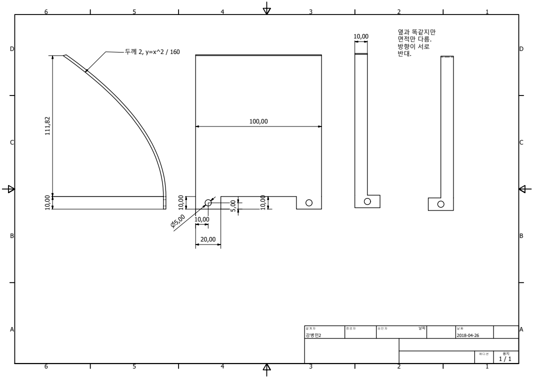
Outline

Assembled Geometry



- Geometry of the Mockup... an old version.
- Radius of two concentric circles of the Holder is tuned with FMPMT cathod and it's cover.
- Pion threshold should be around 485 MeV, but minimum detection threshold will be around 500 MeV, which collects 1 photon/event for each pmt.

Parabolic Mirror



- Parabola with $y = \frac{x^2}{160}; \quad x \in [0, 111.82]$ in units of mm.
- Length is tuned to fit each tip, when fixed at the detector.
- Holes are used to fix the mirror at the holder.

Outline

Decay Channel

Cascade Decay Channel(50%)

$$K^- + p \rightarrow \Xi^- + K^+$$
$$\Xi^- \rightarrow \pi^- + \Lambda$$
$$\Lambda \rightarrow \pi^- + p$$

Lambda Decay Channel(50%)

$$K^- + p \rightarrow \Xi^- + K^+$$
$$\Xi^- + p \rightarrow \Lambda + \Lambda$$
$$\Lambda \rightarrow \pi^- + p \qquad \times 2$$

Decay Process

Schematics of Decay SImulation: $A + B \to C + D$

- Momentum at CoM is determined by M(A+B)-M(C+D)
- Isotropically distributed as $(\cos\phi \sin\theta, \sin\phi \sin\theta, \cos\theta)$, with uniformly random ϕ, θ
- Transform C and D from CoM frame to the Lab frame.
- $C_{Lab} = R^{-1}[\theta] R^{-1}[\phi] \Lambda C_{CoM}$

Simulated Data

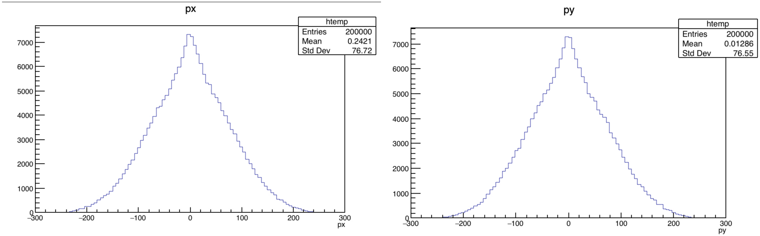


Figure: px and py of the pions.

Simulated Data

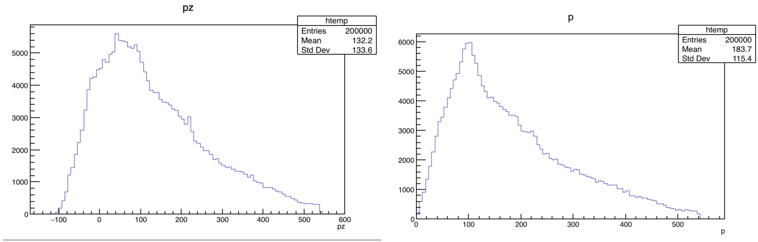


Figure: pz and total momentum of pions.

Simulated Data

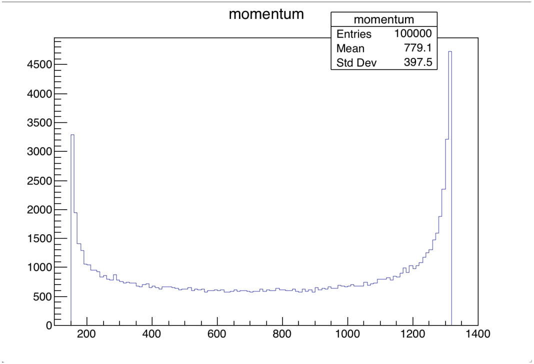


Figure: K^+ momentum distribution

Simulated Data

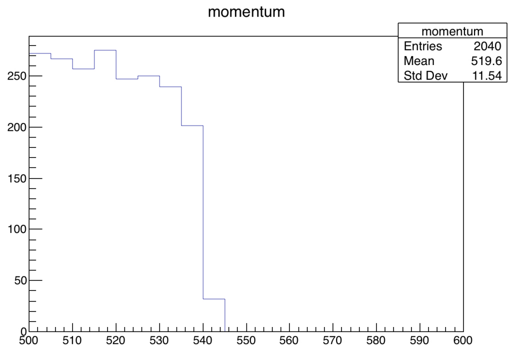


Figure: 2040 pions out of 100 K events are over 500 MeV.

Outline

Model(by Minho)

ADC vs Distribution

$$Q(x) = N_1[e^{-\mu}Q_0(x) + \sum_{i=1}^{\infty} \frac{e^{-\mu}\mu^i}{i!} \sum_{j=0}^{i} p^j(1-p)^{i-j}\binom{i}{j} Q_{ij}(x)]$$
$$+ N_2[e^{-\mu}Q_0(x) + (1 - e^{-\mu}\Theta(x - x_0)\alpha e^{-\alpha(x-x_0)})]$$

- p is the probability to hit the first dynode, μ is average at poison dist., N1 and N2 is the ratio of dark current and signal
- $Q_0(x) = Gaus(x, x_0, \sigma_0)$ is the pedestal, $x_0 = 50$, $\sigma_0 = 1$.
- $Q_{ij} = Gaus(x, x_0 + (jg + (i-j)g/g_1), \sigma_0\sqrt{jg + (i-j)g/g_1})$ where g is the gain factor, g_1 is gain at 1st dynode.

Simulation Result

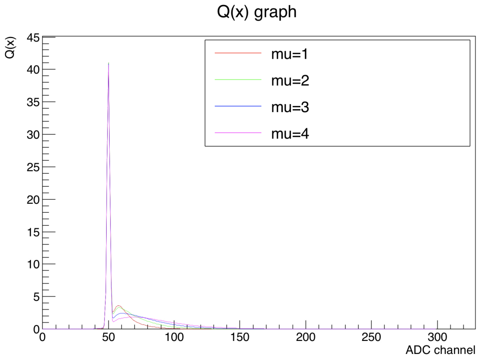


Figure: Simulated result with various μ. Other parameters are, x_0=50, σ_0=1, g=22.5, g_1=1.9, p=0.5, α=0.5, N1=100, N2=1. g, g_1, p was given at the paper. Other parameters were chosen arbitrarily

Further wokrs to do.

- Send the plan sheet of the mockup.
- Add additional decay channels to the kinematics simulation.
- Set proper ratio for the decay.