2024/5/1 CALICE meeting

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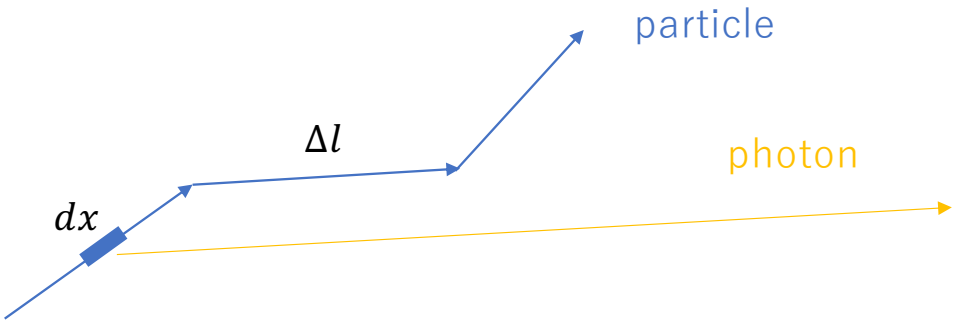
Status

- Digitized the Cherenkov signals with Poisson distribution.

- Used a quartz as the Cherenkov detector and set the same sampling fraction as that of DREAM cal to compare the resolution improvement with the DREAM result fairly.

Digitized Cherenkov signals

- The number of generated Cherenkov photons：



The number of generated Cherenkov photons in $\lambda = \lambda \sim \lambda + d\lambda$, in dx is,

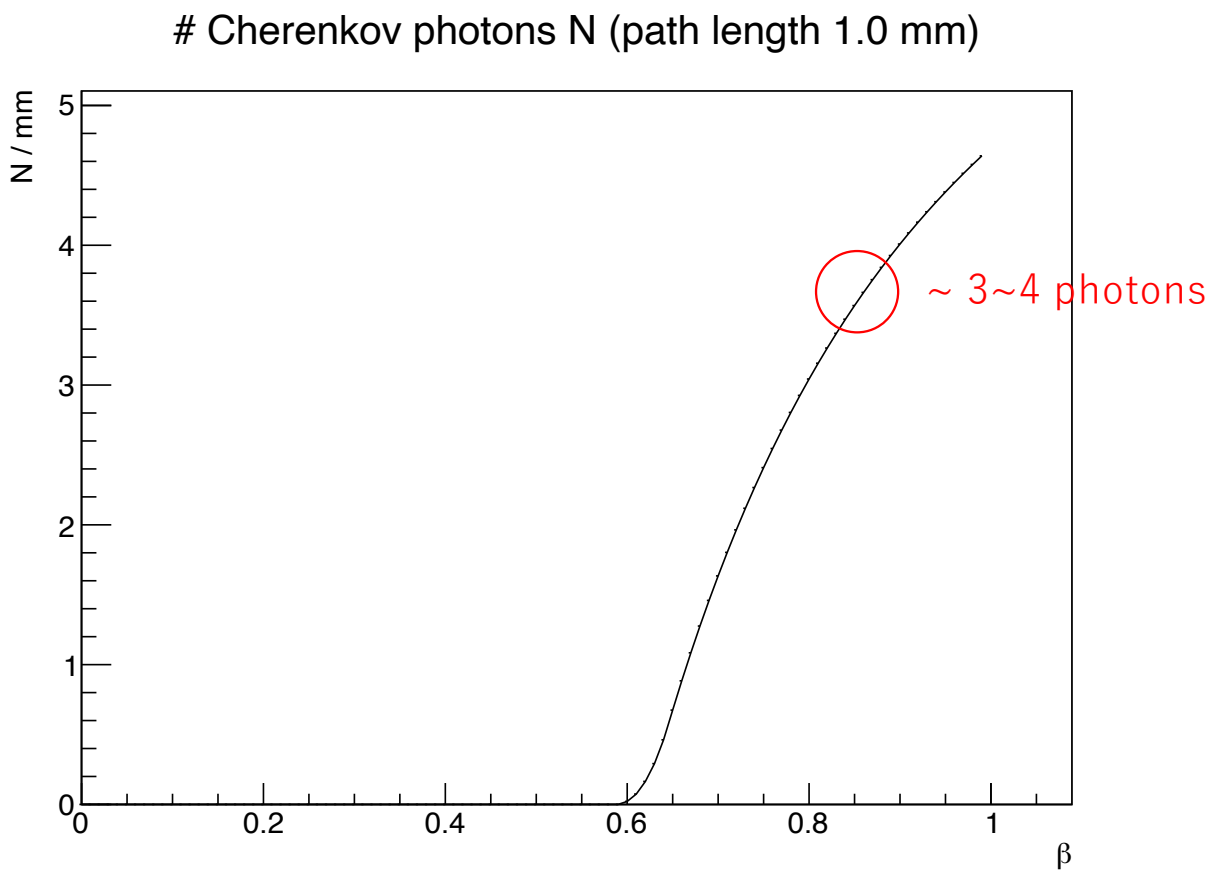
$$\frac{d^2N}{dxd\lambda} = \frac{2\pi Z^2\alpha}{\lambda^2}\left(1 - \frac{1}{n^2(\lambda)\beta^2}\right).$$

- Digitization:
  - Mean: $\widehat{N}_{\mathrm{det}} = \Delta l \cdot \int_{\lambda_{\mathrm{min}}}^{\lambda_{\mathrm{max}}} \frac{2\pi Z^2\alpha}{\lambda^2}\left(1 - \frac{1}{n^2(\lambda)\beta^2}\right) d\lambda$
  - Digitized: $N_{\mathrm{det}} = \mathrm{rand.Poisson}(\widehat{N}_{\mathrm{det}})$

(Appendix)

- How many Cherenkov photons generate when mip particles travel:
  - Equation: $\widehat{N}_{\mathrm{det}} = \Delta l \cdot \int_{\lambda_{\mathrm{min}}}^{\lambda_{\mathrm{max}}} \frac{2\pi Z^2 \alpha}{\lambda^2}\left(1 - \frac{1}{n^2(\lambda)\beta^2}\right) d\lambda$
  - Use a quartz. (NIFS-V made by NIKON)
  - Set $\lambda_{\mathrm{max}} = 200\ \mathrm{nm}$ and $\lambda_{min} = 150\ \mathrm{nm}$
  - Absorber: Cu -> mip e^- energy ~ 1 MeV ~ $\beta \sim 0.86$

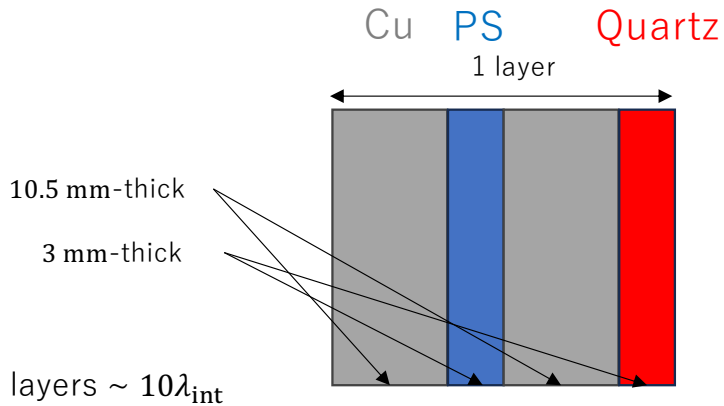
- Generated # Cherenkov photons while e^- travels 1 mm in the Quartz:



Comparison with DREAM

- The sampling fraction of DREAM (Scintillator): $\sim 2.1\,\%$.
  - Set the same detector materials.
  - Adapted the same detector volume fraction:

    Absorber (Cu) : Scintillator (PS) : Cerenkov (Quartz) : Air ~ 7 : 1 : 1 : 1 .



Total: 72 layers ~ $10\lambda_{\mathrm{int}}$

Length of 1 layer: 31.4 mm