

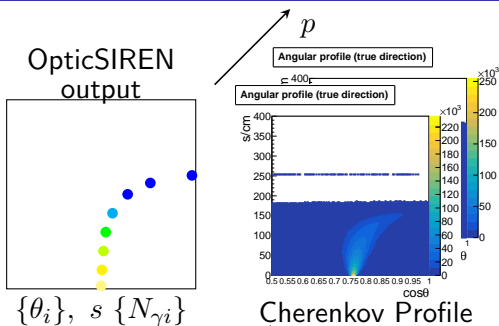
# Current status and Goal

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CIDeR-ML workshop  
April 10, 2025

# Momentum Reconstruction



- I am (was) developing an algorithm to reconstruct momentum from Optic SIREN output.
- Likelihood:

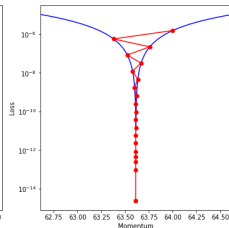
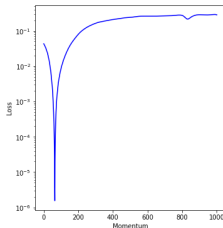
$$\mathcal{L}_i \sim \exp\left(-\frac{(N_{\gamma i} - N_{\text{CP}})^2}{2\sigma^2}\right).$$

$(N_{\text{CP}} = N_{\text{CP}}(\theta_i, s_i, p).)$

$$\mathcal{L}(p) = \prod_i \mathcal{L}_{\text{CP}}(p, \theta_i, s_i)$$

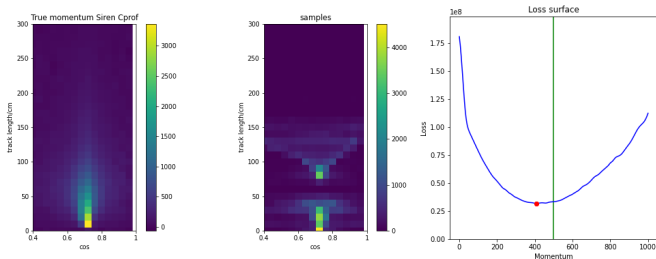
Minimize  $-\ln \mathcal{L}$  by GDM

$p_{\text{best-fit}}$



# Electron (500 MeV/c)

- I tried to reconstruct momentum of one-event Cherenkov Profiles.
- The minima of the loss (red point) are not consistent with the true momenta (green line).
  - If emitted electromagnetic showers appear in an event, the photon emission distribution becomes different from the Cherenkov profile



NN representation

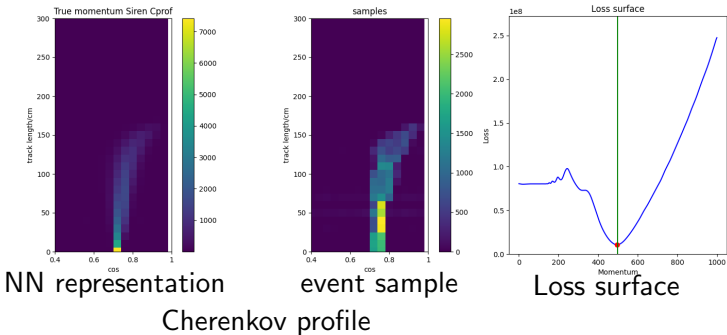
event sample

Loss surface

Cherenkov profile

# Muon (500 MeV/c)

- The minima of the loss are very consistent with the true momenta.
  - $\mu^-$ 's do not emit electromagnetic showers.
  - The Cherenkov profile is similar to the ground truth.



# Goal of the 2025 spring workshop

- Check the momentum bias problem that Cesar mentioned earlier.
  - There is a bias of reconstructed momentum on the high momentum region.
  - This topic study should be started before the workshop.
  - The reason of problem is probably Cesar's definition of loss.
    - First, I will check if there is the bias in my loss definition or not.
- Develop the connection part between Phys and Optic SIREN.
  - Make a pipeline of the demonstration.
  - Ka Ming and Ryo work on this topic.
  - I will join this development as soon as the bias study is completed.
- (Continue to develop minimization algorithm)