Status Report

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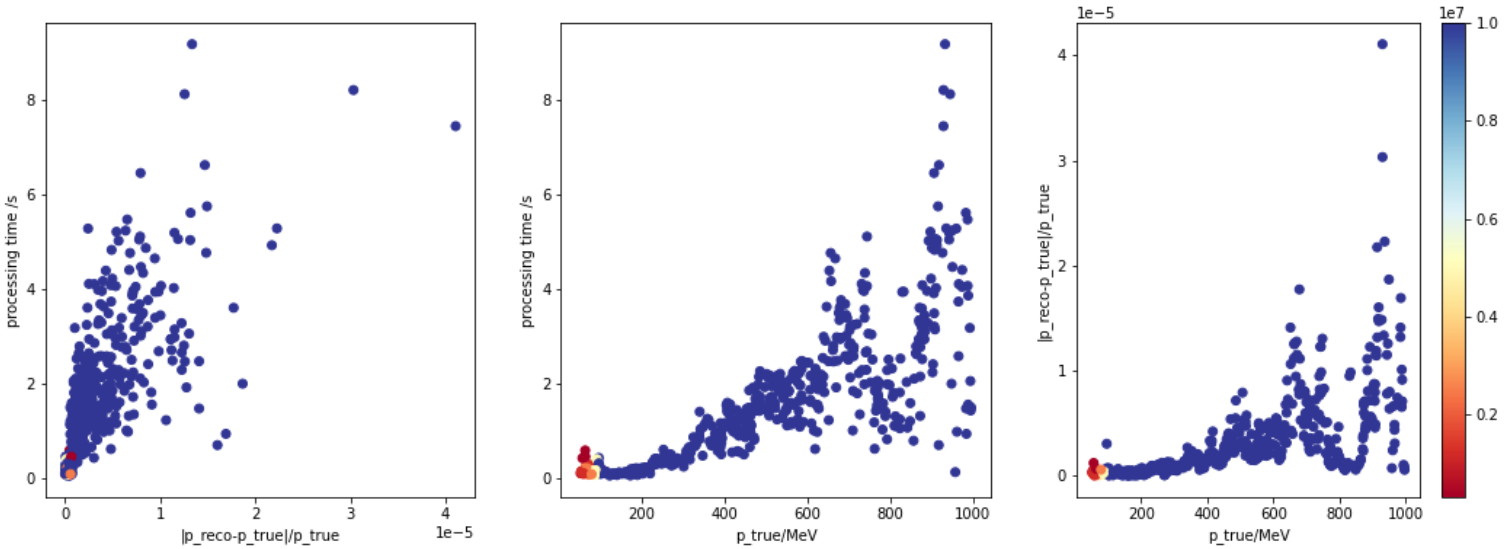
Momentum reconstruction: reminder

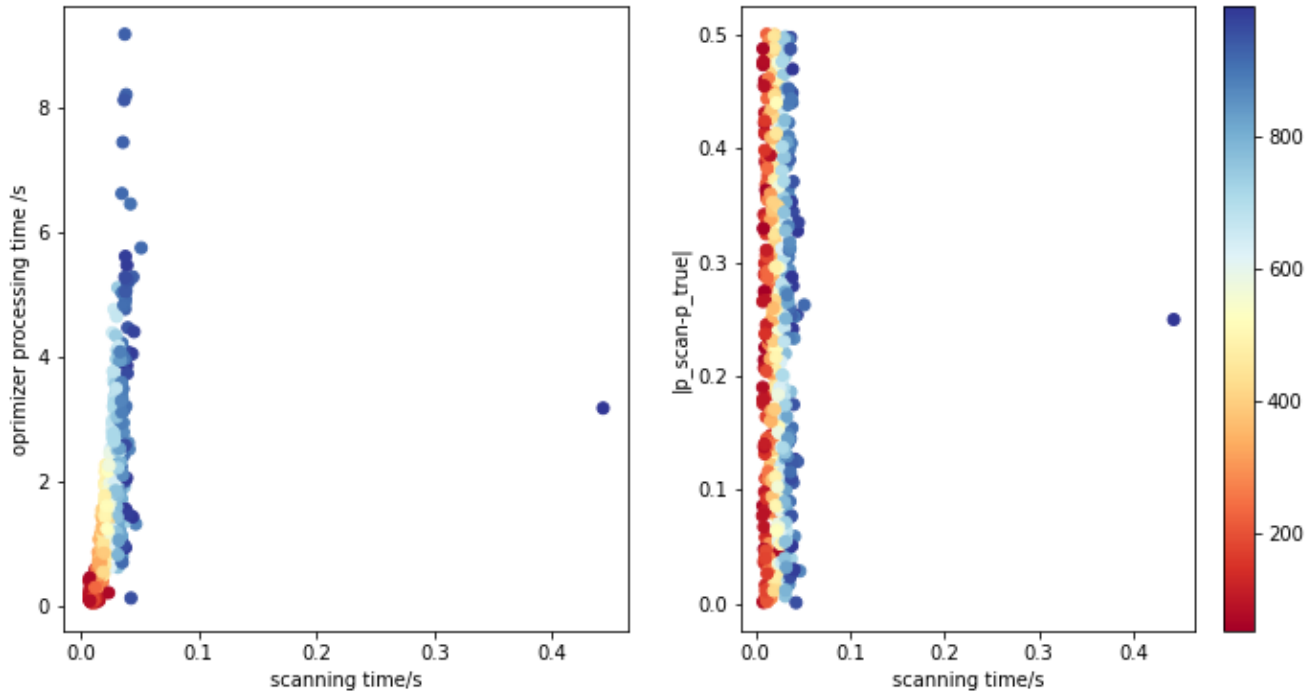
- I develop a algorithm to reconstruct momentum from OptSiren output (number of photon and angle of track segments).
  - Reconstruct by minimizing the loss function (gradient descent method).
- The reconstruction algorithm takes long time 1 sec.

Processing time and learning rate



- color: learning rate.
- I introduced an algolithm to halve the learning rate if $\Delta p_i > 1\ \mathrm{MeV}/c$ for each iteration.
- Finish iteration if $|\mathcal{L}_i - \mathcal{L}_{i-1}| < 10^{-14}$.
- Reconstruct 500 fake data (randomly selected 0-1 GeV momentum samples) to evaluate performance.
  - When using low learning rate (low momentum), the processing times did not become long.
  - Reconstruction of high momentum sample sometime take longer time.

Oprimize and scan

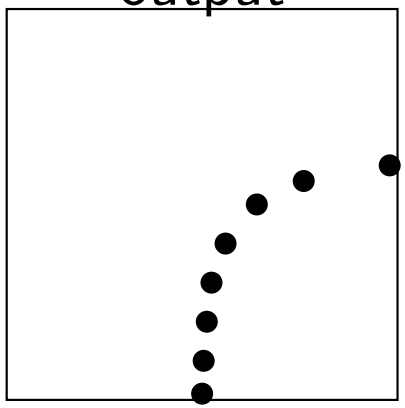


- color: True momentum/MeV.
- instead of running optimizer, just scan all momentum between 0-1GeV in 1 MeV steps and take minimum.
  - The scaning method takes 10 ms.
  - The error was always less than 0.5 MeV.
  - There is one sample that took a long time, therefore I will check what kind of event it is.

appendix

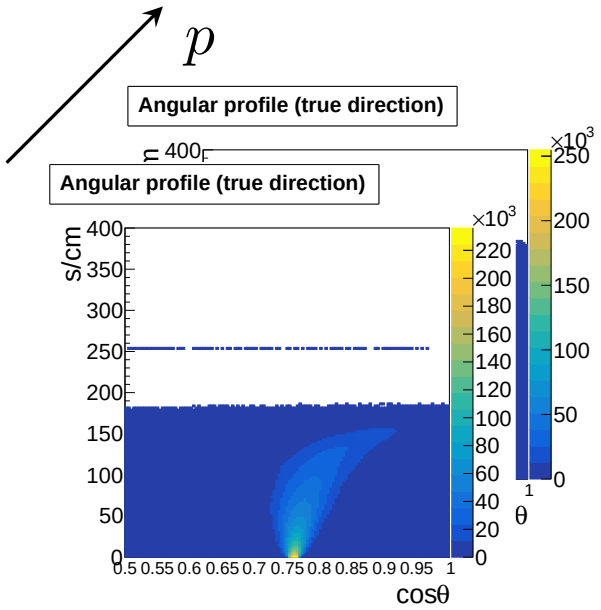
appendix: Reconstruction

OpticSIREN output



$\{\theta_i\},\ s\ \{N_{\gamma i}\}$

p



Cherenkov Profile

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

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

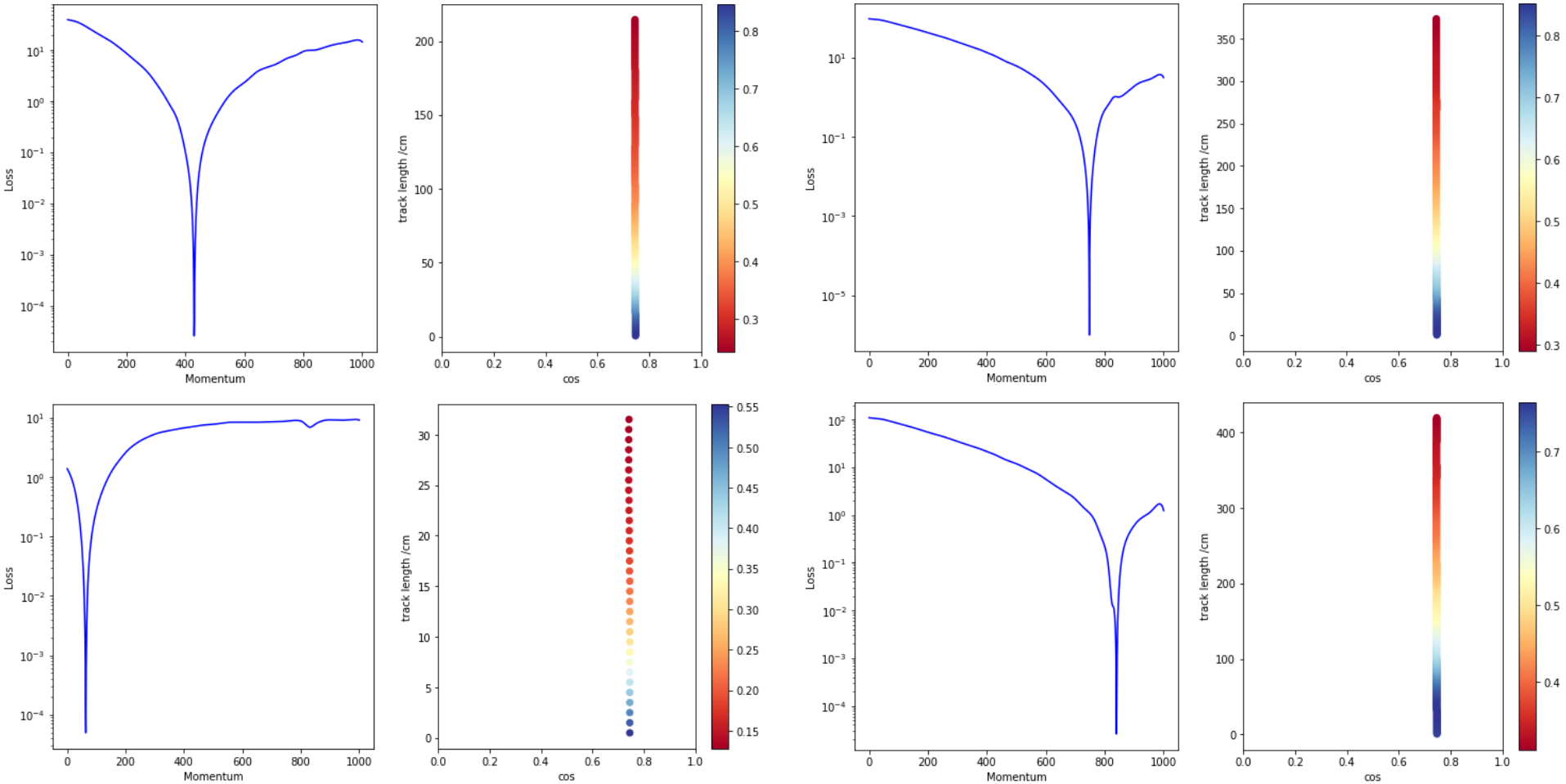
$p_{\mathrm{best-fit}}$

- I used a maximum-likelihood method for the reconstruction.
- Likelihood:

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

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

appendix: Fake data examples



- color: number of photon.