

Siren pipeline for WCTE cosmic muon calibration

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Validation of OpticSiren Performance

To validate the performance of the OpticSiren, the idea is to compare the PMT response by followed simulation process

Simulation: Geant4, CherenkovSiren&OpticSiren

	Input	Output
True (Geant4 simulated MC)	True vertex, direction	Geant4 PMT charge (P.E.)
Siren	True vertex, direction	Siren PMT charge (P.E.)
fiTQun input Siren	fQ reco vtx, dir	Siren PMT charge (P.E.)
Smeared input Siren	Smear the true input (vtx, dir)	Siren PMT charge (P.E.)

Some comparison has been done include:

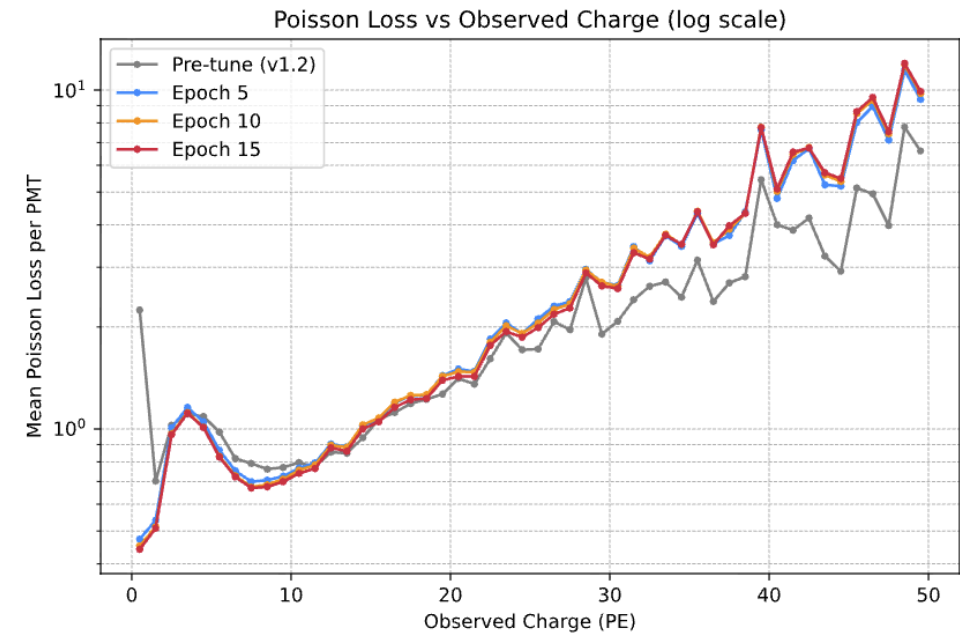
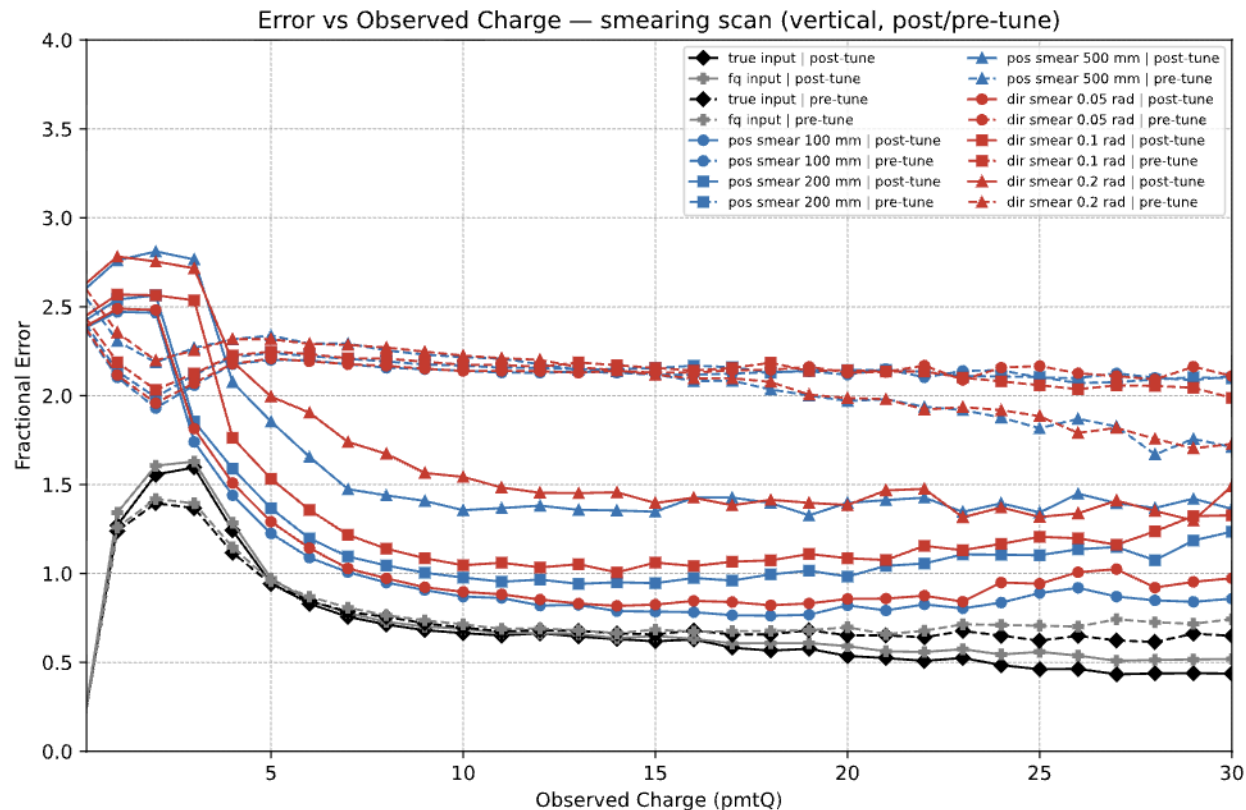
2-D charge maps of Geant4 vs Siren

Fraction of differences $2 \cdot (\text{Siren} - \text{Geant4}) / (\text{Siren} + \text{Geant4})$ as a function of Geant4 charges

1-D uncertainties of this fraction of differences

Status of the validation

- Studies did in past few weeks show changing the true input to fiTQun reconstruction information doesn't impact too much in the results, but the reasons making the post-tuning model simulatd change has a bias need to be investigated
- Additional study on loss as a function of PMT charge for pre-tune, epoch 5, 10, 15



Test the sampling

There are a few parameter for sampling:

Step of length along the track : 1, 2, 5, 10, 20 (mm)

Step of costheta (“costh_step”): 0.002, 0.005, 0.05

Sampling range of costheta

Number of phi: 36, 72

Step size of the length along the track

Make a finer step size of length along the track doesn't improve the result

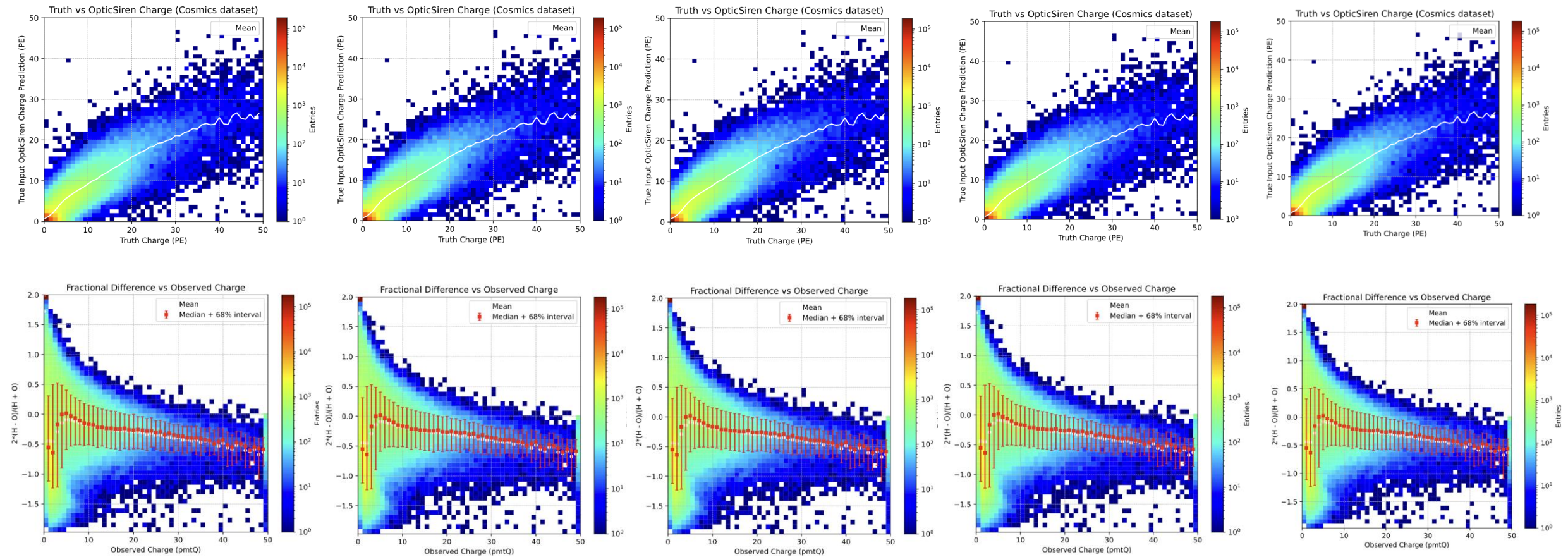
1mm

2mm

5mm

10mm

20mm

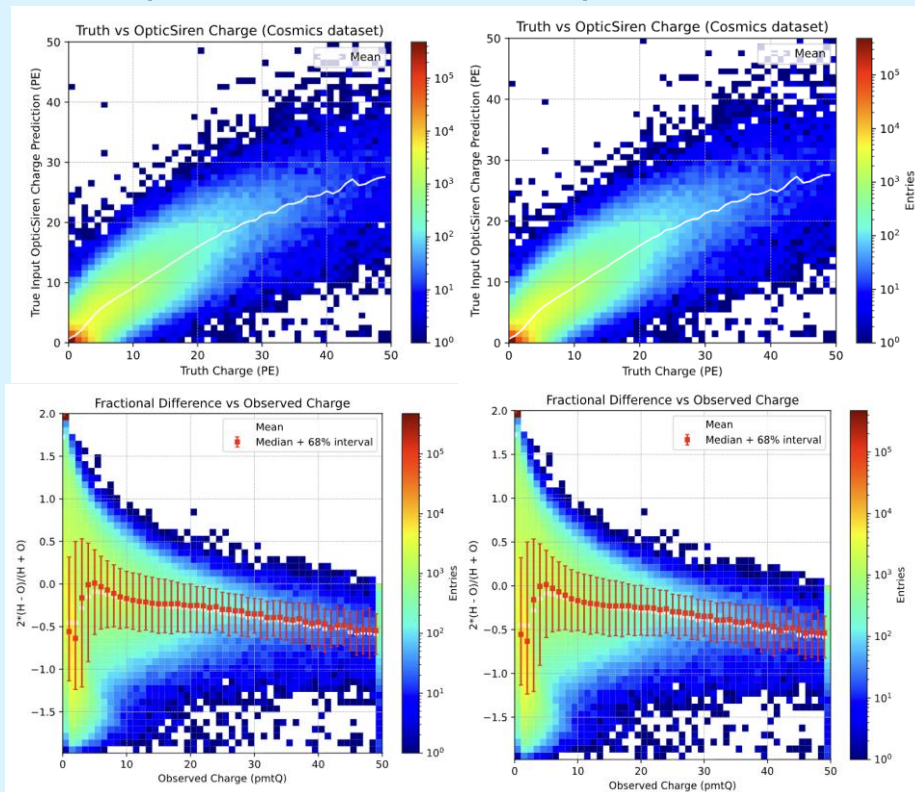


Sampling of costheta

Check the step size

Step size = 0.002

Step size = 0.005



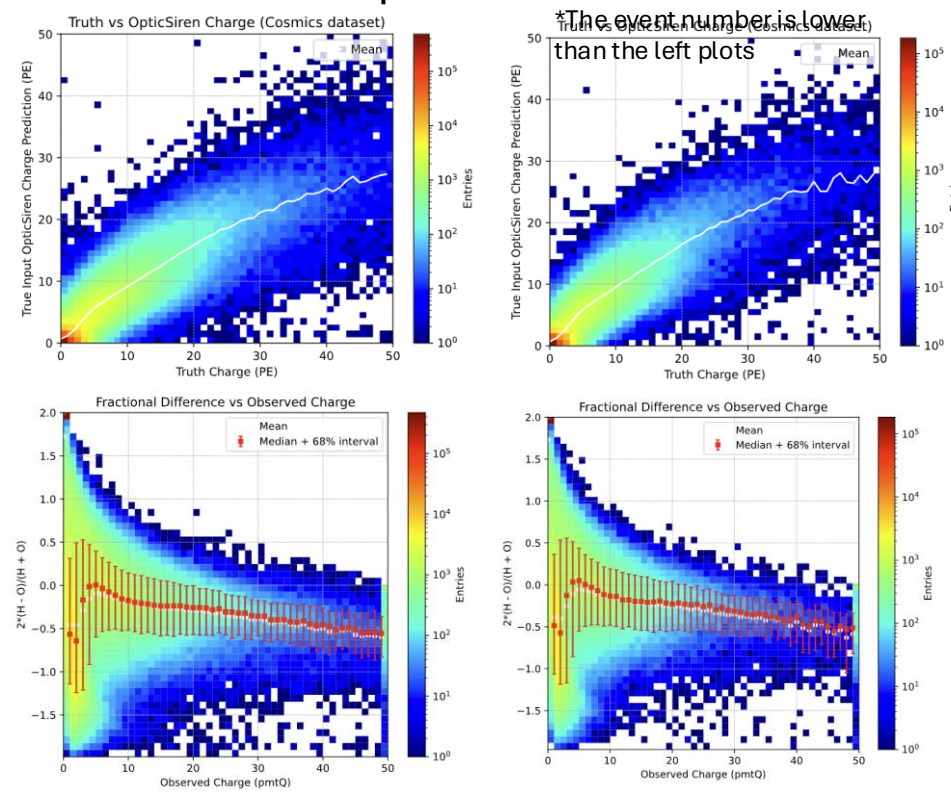
Narrow Cherenkov Cone Sampling:

Costheta [0.7,0.8]

Making the step size of costheta finer doesn't improve the results

Check the costheta range

Step size = 0.005

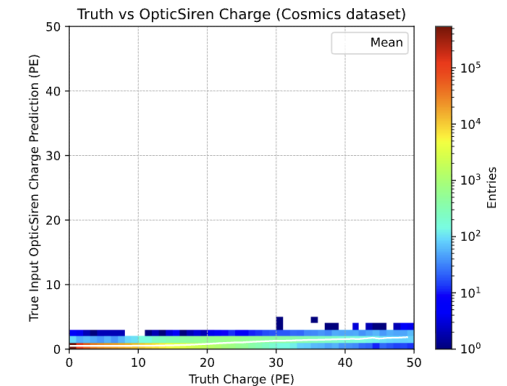


Costheta [0.72,0.78]

Making range of costheta narrower or wider doesn't improve the results

Step size = 0.05

Costheta [-0.975,0.975]

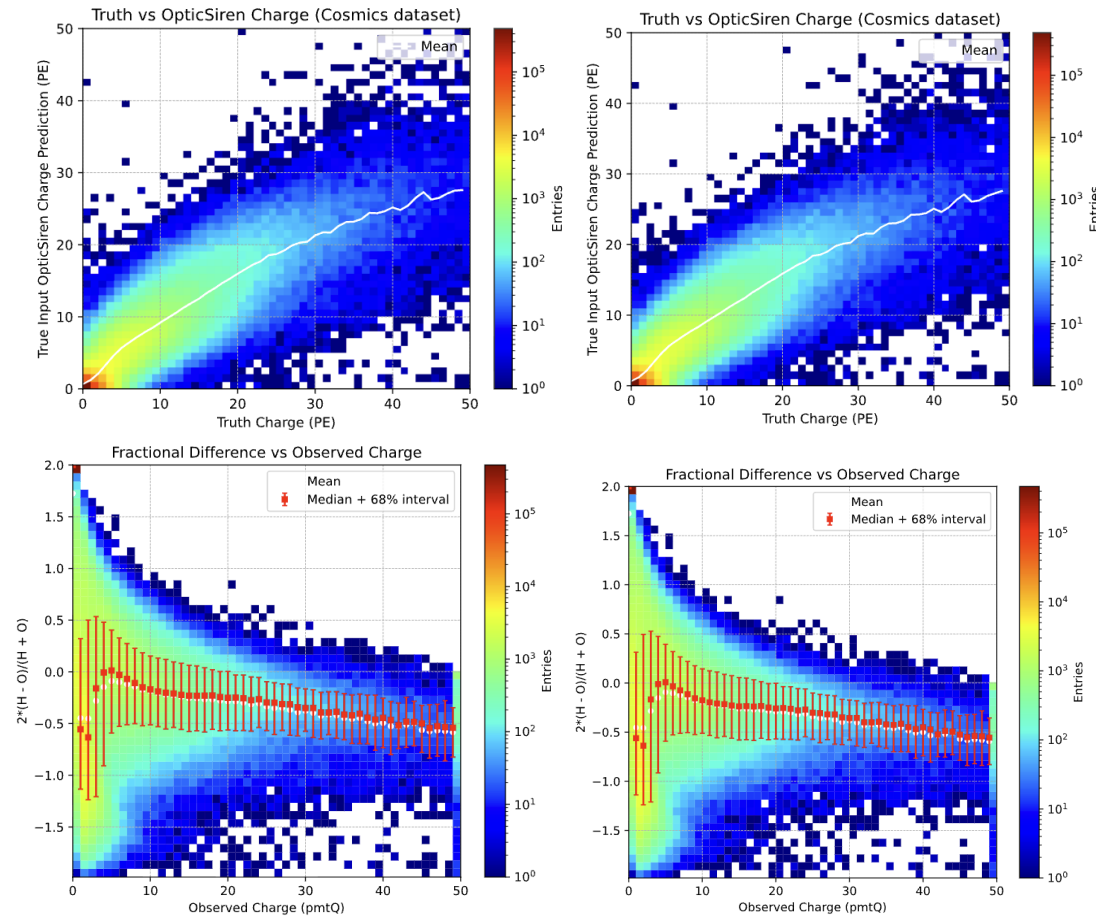


If the steps are too coarse many information lost at the Cherenkov cone – it make the result worse

Double the number of phi

Nphi=36

Nphi=72



Make the phi bins fines doesn't improve the results

Summary of sampling testing

Step of length along the track (“distance_step”): 1, 2, 5, **10**, 20 (mm)

Step of costheta (“costh_step”): 0.002, **0.005**, 0.05

Sampling range of costheta

Number of phi: **36**, 72

Make the sampling more accurate doesn't improve the results

Need to validate other pieces:

Update the Cherenkov profile for cosmic muons?

Summary and to-dos

- The Study on the sampling schemes show making the sampling more accurate doesn't improve the OpticSiren simulation performance
- Cherenkov profile may need to be updated for cosmic muon -> Aim to look into it by the workshop
- Tested the updated reconstruction pipeline, plan to test the OpticSiren cosmic calibration with the reconstruction information.