Introduction of the calibration framework

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CIDeR-ML collaboration meeting

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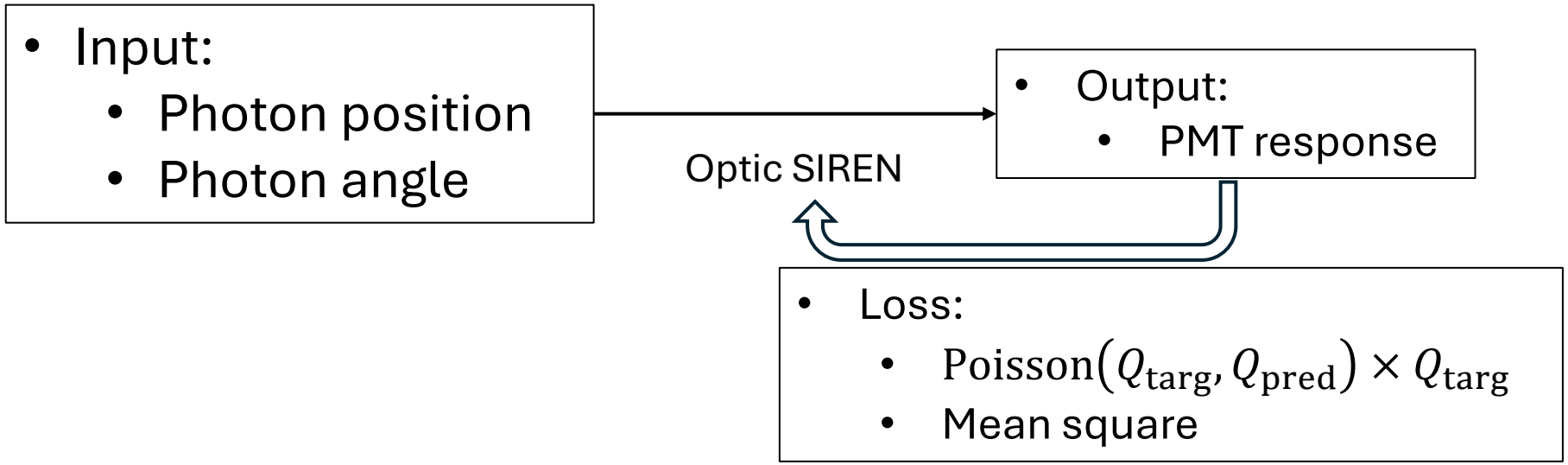
Optic SIREN

- Simulates PMT responses of each photon.



- For test of training, use calibration sources on WCTE:
  - LEDs
  - Laser diffuser ball
  - NiCf source
  - Cosmic muon

} Focus on the isotropic sources

Training by Isotropic Sources

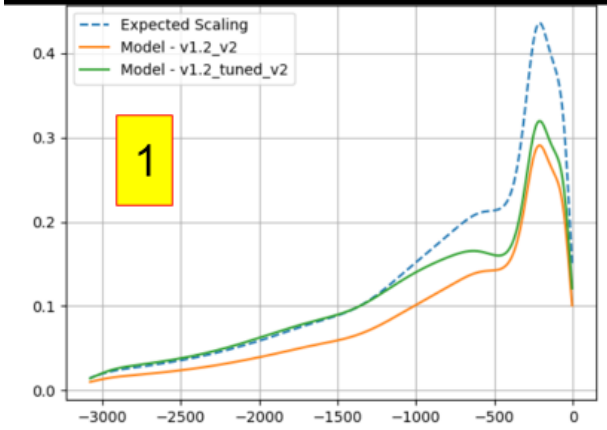
- Isotropic emission:
  - Input (OpticSIREN):
    - Positions of sources (r, φ, z) for each sources
    - Directions $(\theta, \varphi) \times$ # of photon per each source (intensity)
  - Output:
    - Charge predictions × 1843 PMTs for each sources
- Using given intensity of sources.
- Aim to train the OpticSIREN using fake data (increasing the PMT charge of MC by some factor (e.g. 1.5x).

Current status

- Nico tested training about 4 types of the configurations:
  1. 3 source positions: $(0, 0, 0), (0, 0, \pm 1000)$
  2. 3 source positions: $(0, 0, 0), (0, 0, \pm 1300)$
  3. 15 source positions:
     $z = [0, \pm 1300], r = [0, 1160], \varphi = [0, 90, 180, 270]$
  4. 126 source positions:
     $z = (-1300, 1300, 14), r = [0, 580, 1160], \varphi = [0, 90, 180, 270]$
- Fake data factor: 1.5

Level 1 Test

Level 1: Normal Incidence (Barrel)



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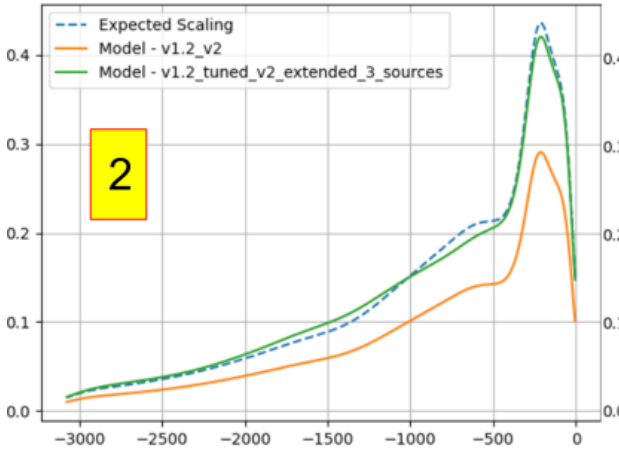
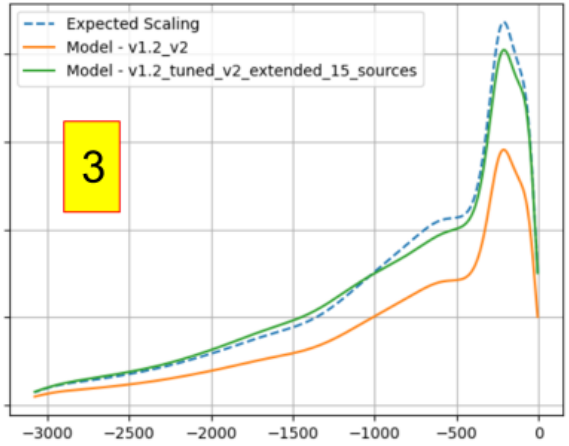
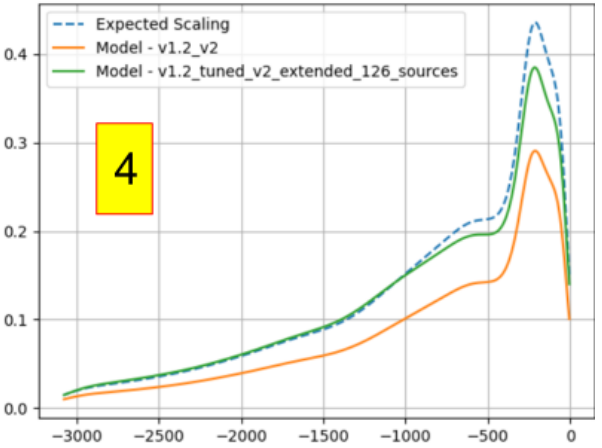
x: Distance from PMT
y: Visibility
dotted: expect scaling

PMT = 19 (Barrel)



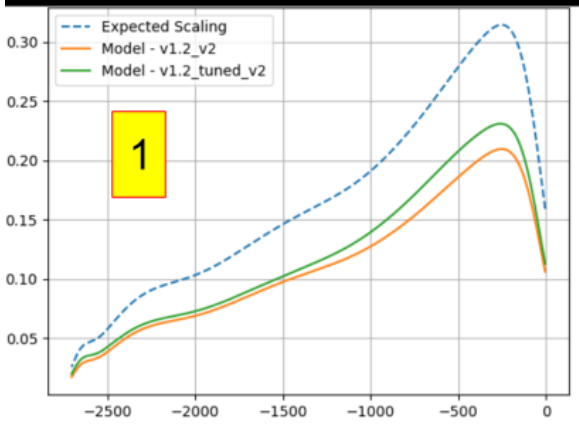




Nico's slides(https://github.com/CIDeR-ML/OpticSiren/tree/Nico)

Level 1 Test

Level 1: Normal Incidence (Bottom)



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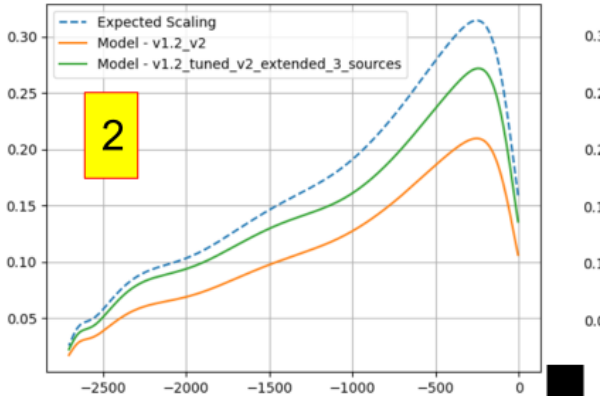
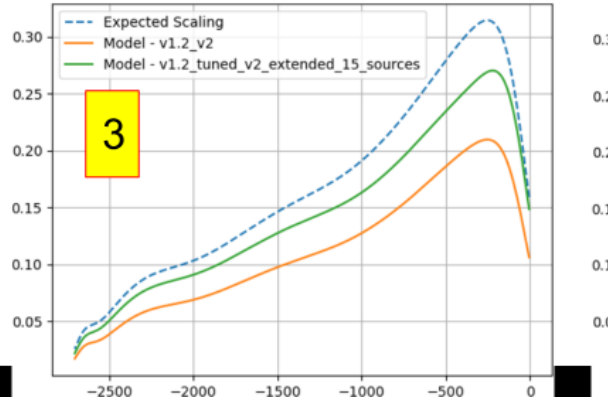
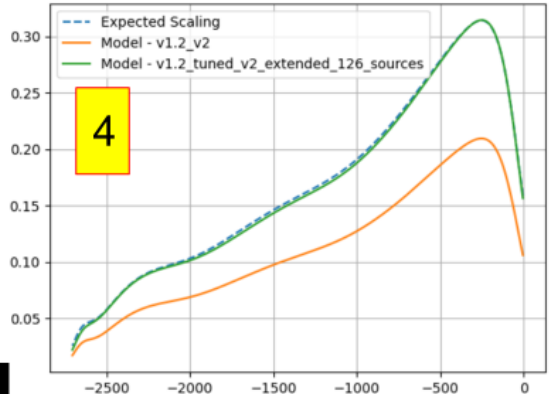
dotted: expect scaling

PMT = 1026 (Bottom)

Training source on the sampling line

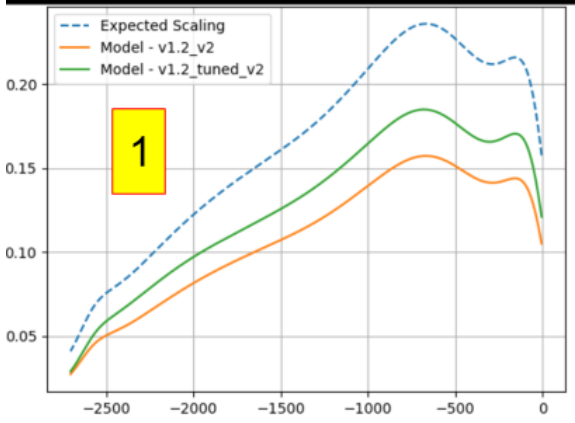






Level 1 Test

Level 1: Normal Incidence (Top)



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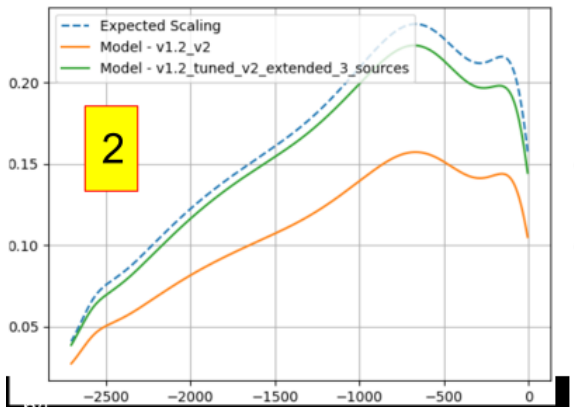
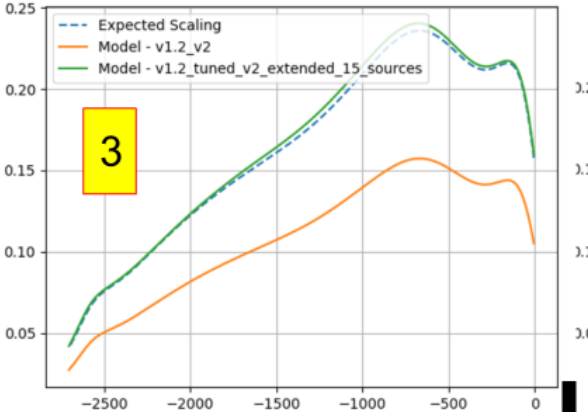
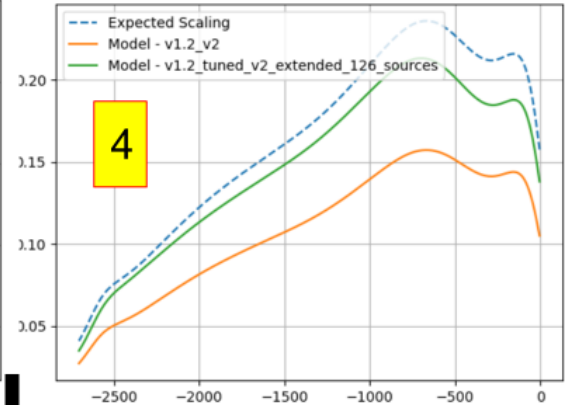
x: Distance from PMT
y: Visibility

PMT = 1615 (Top)

No training source on the sampling line





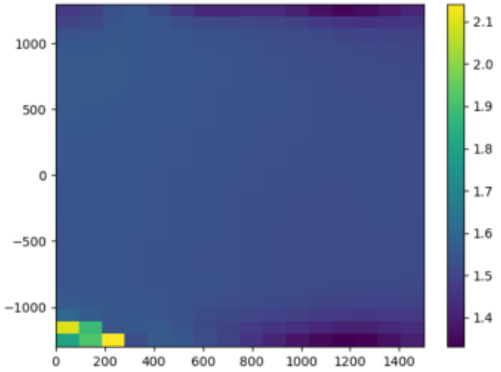


- Top and Bottom Cap shows worse tuning effect than Barrel
- Having more sources doesn't always make better results.

Level 2 test

Level 2: Arbitrary point to PMT

1



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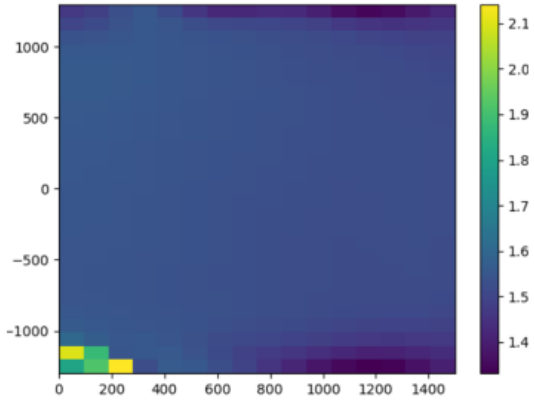
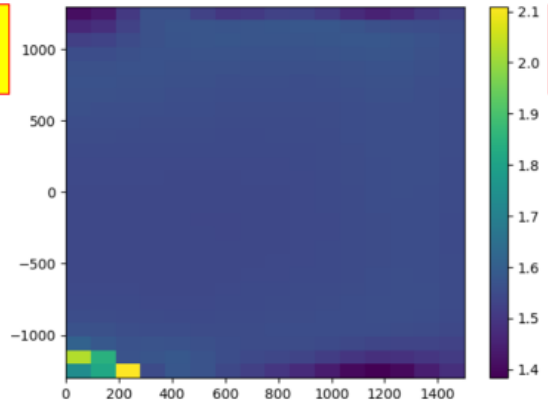
x: r values
y: z values
z: Visibility ratio

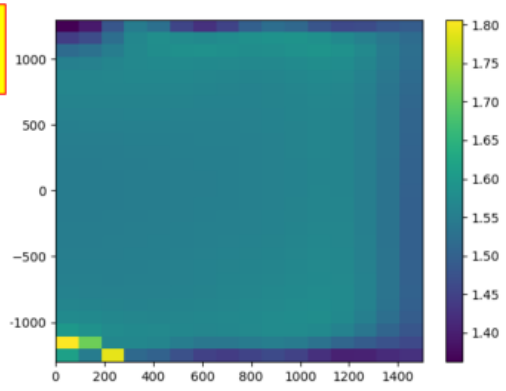
2



3



4



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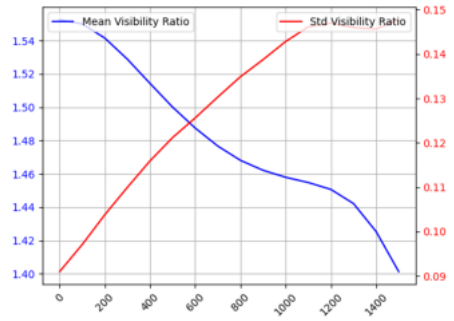

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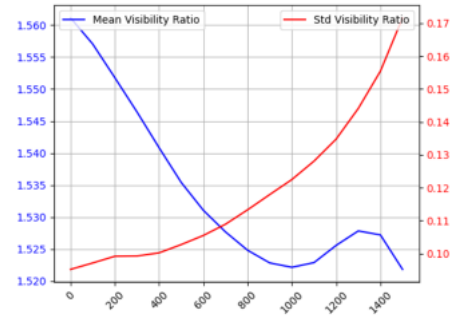
x: r values
y: Visibility ratio
certain z

red: std
blue: Mean

2



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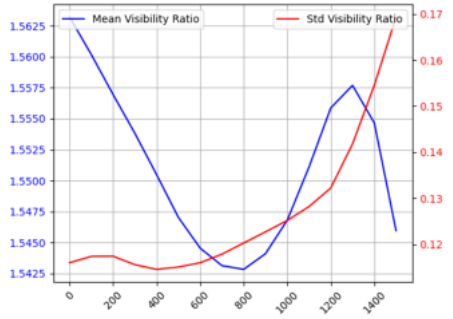
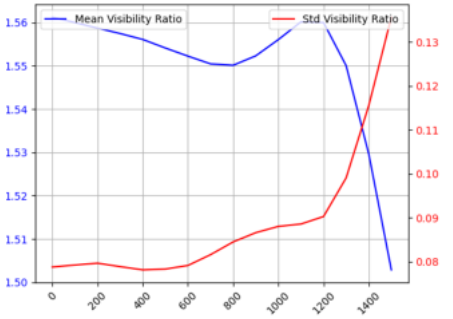


4



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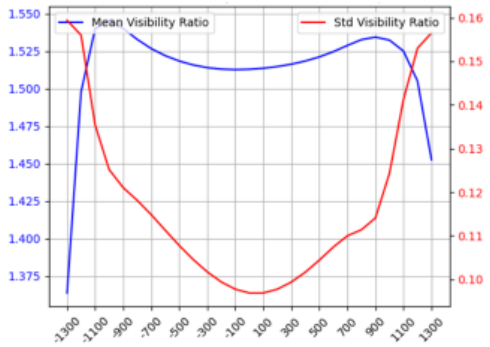
Level2 Test

Level 2: Arbitrary point to PMT

1



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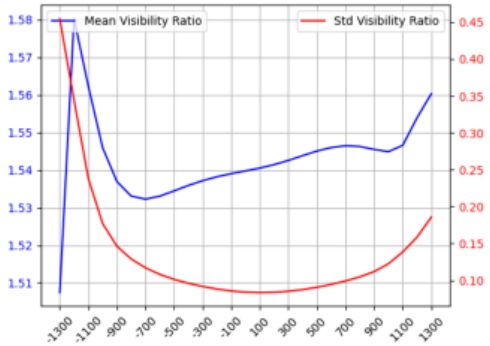

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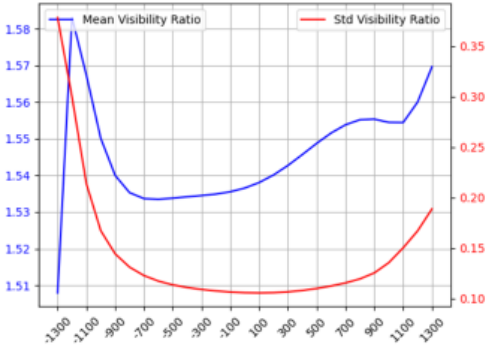
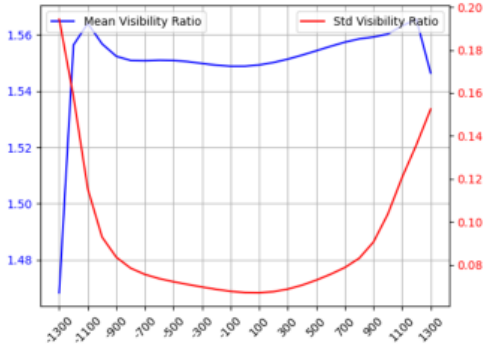


4



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Level 2 test

- For case 1 and certain z, the visibility ratio decreases with r.
- For all cases and certain r, the visibility ratio has less dependence of z.
- The fluctuation can get smaller by extending the source positions.
- Visibility ratio: 1.53-1.56

My plan of this workshop

- Take over Nico's calibration study.
  - Try to increase the calibration sources.
  - Apply different types of scaling
  - Decide what to do going forward
- Day-to-day plan:
  - Day1: test Nico's codes.
  - Day2: try using more angles
  - Day3: try using non-symmetric sources.
  - Day4 (5): apply different types of scaling and decide on the calibration plan for day 5 and beyond.