

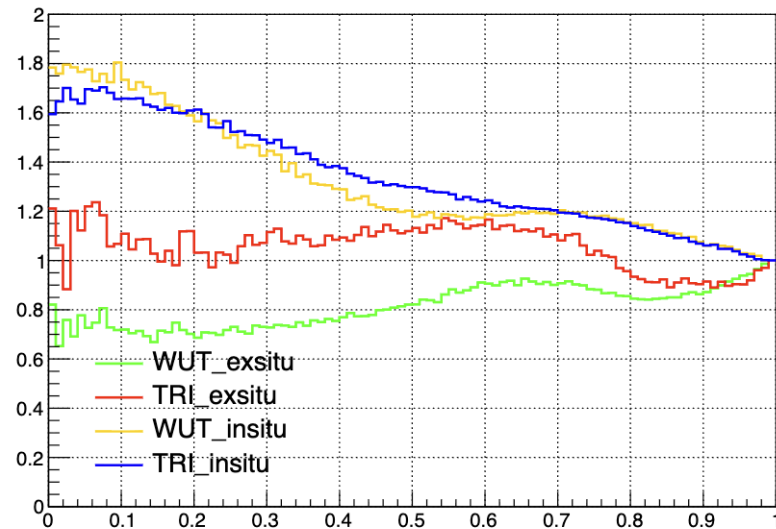
SIREN PMT Angular Response with WCTE Cosmic data

Zhenxiong Xie

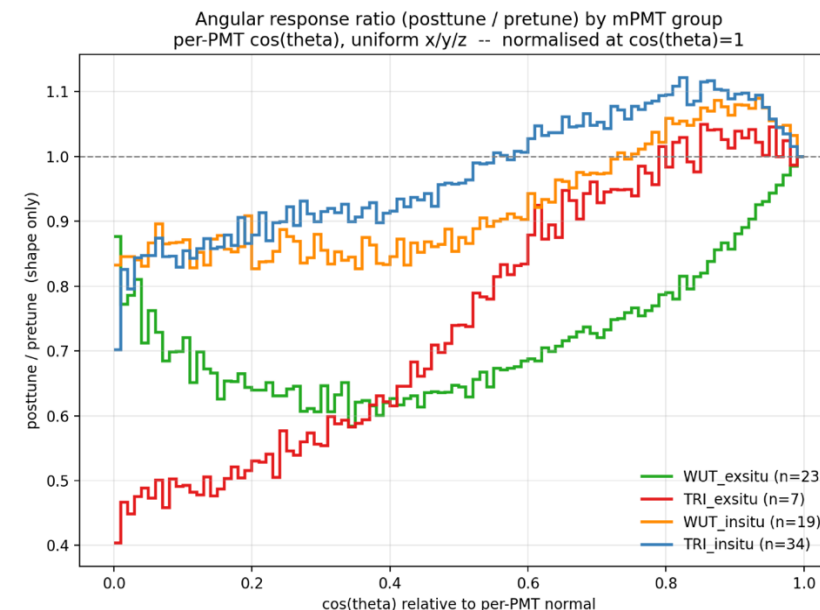
Status of angular response with OpticSiren

From the discussion on last week, the methods of how Ka Ming computed the angular response using fiTQun reconstruction (CosmicAnalysis) and how the OpticSiren computes the angular response need to be clarified.

CosmicAnalysis
(normalized last bin to 1)



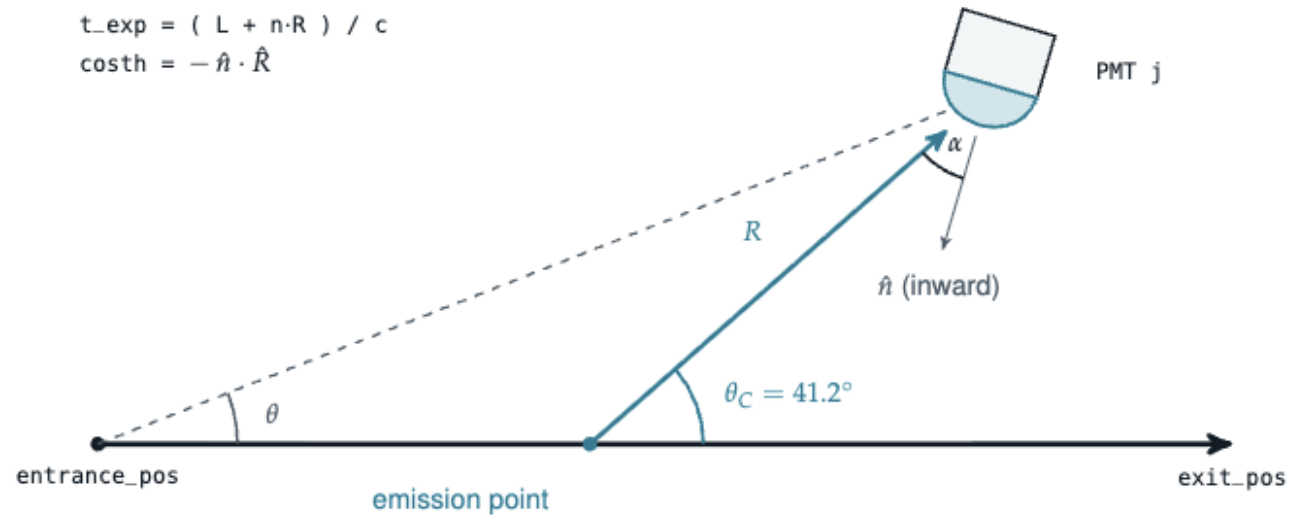
OpticSiren



Angular response in CosmicAnalysis

ONE TRIANGLE PER PMT

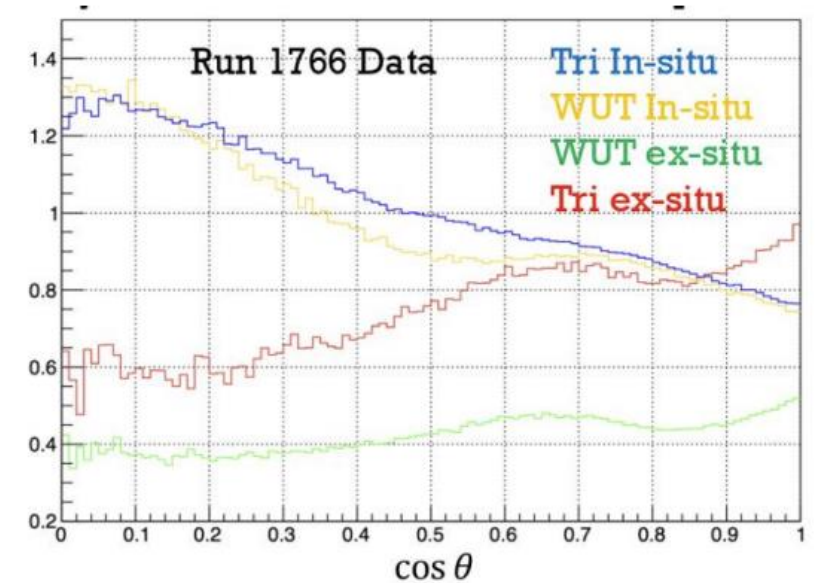
$$t_{\text{exp}} = (L + n \cdot R) / c$$
$$\cosh = -\hat{n} \cdot \hat{R}$$



The Cherenkov angle fixes where on the track the light that reaches PMT j was emitted — and therefore its expected arrival time, its path length R , and the angle α at which it strikes the PMT face.

WHAT IS MEASURED

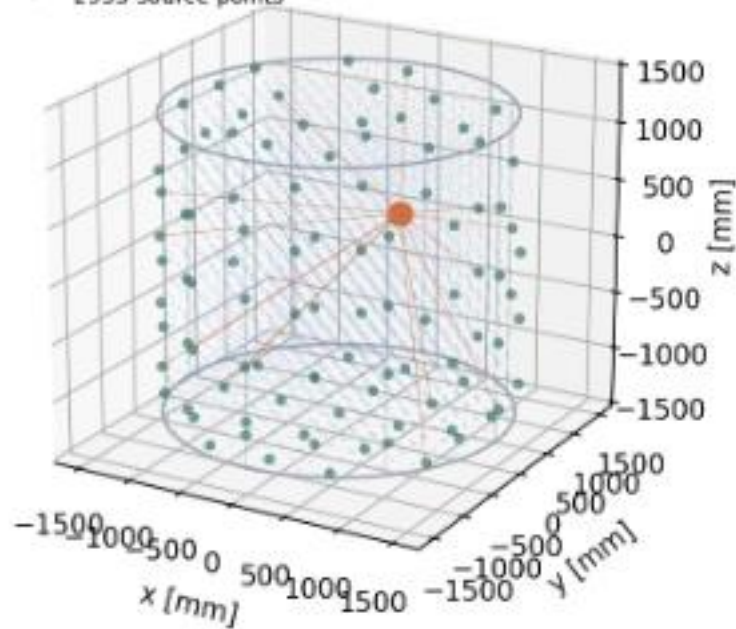
$$A_g(\cos \alpha) = \frac{\langle Q \cdot R \rangle_{\text{data}}}{\langle Q \cdot R \rangle_{\text{nom. MC}}}$$



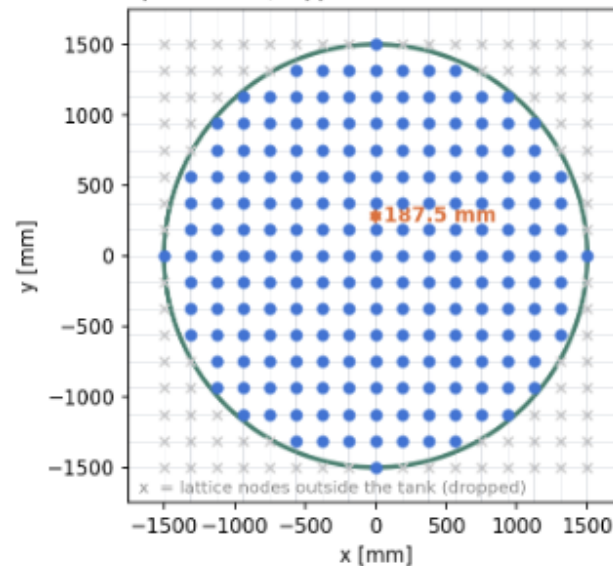
How does Siren compute the angular response sampling the source point uniform in the WCTE tank

A — the source lattice inside the tank
orange: one source is paired with every mPMT

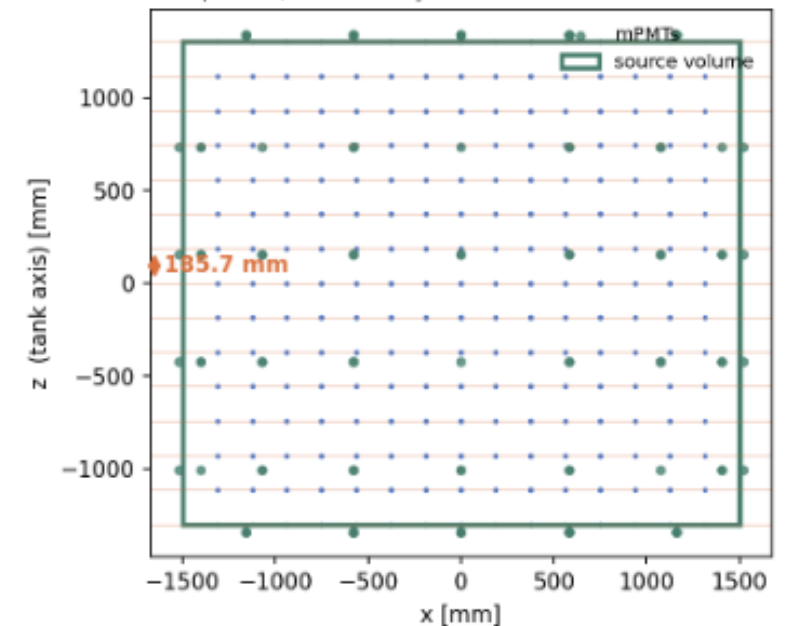
- 97 mPMTs
- 2955 source points



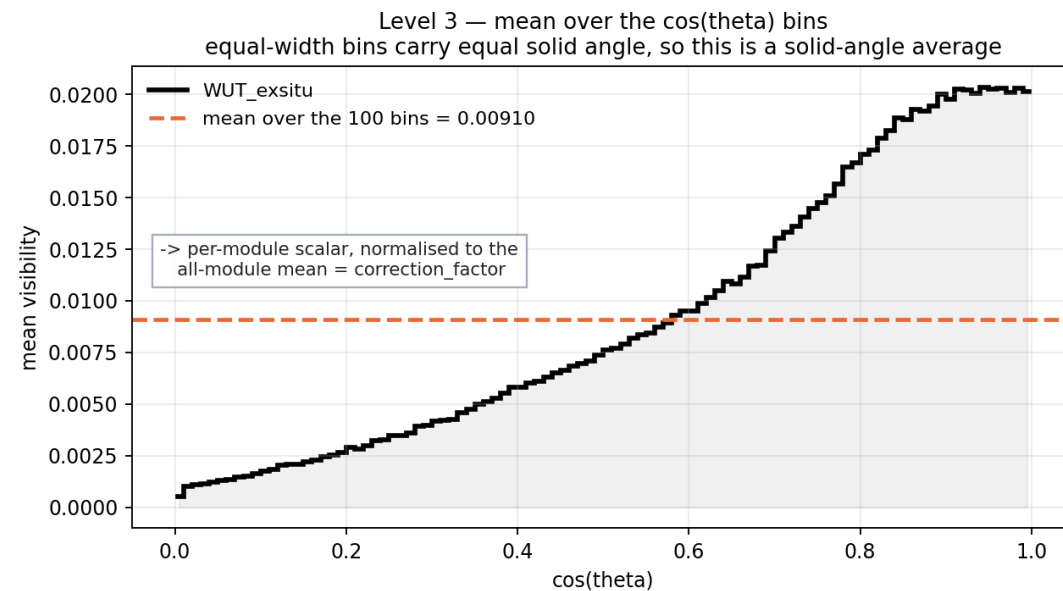
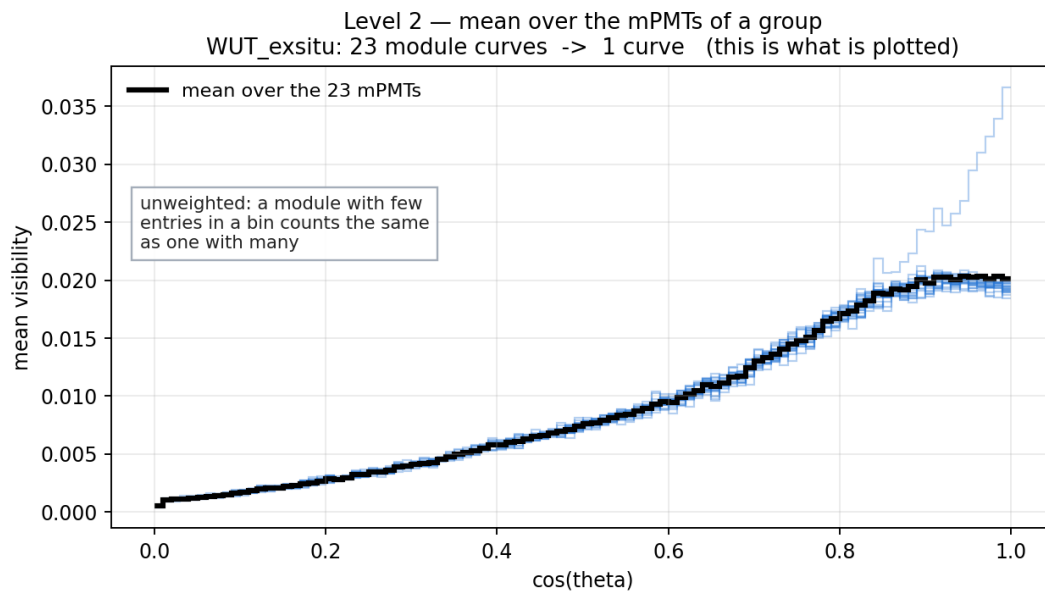
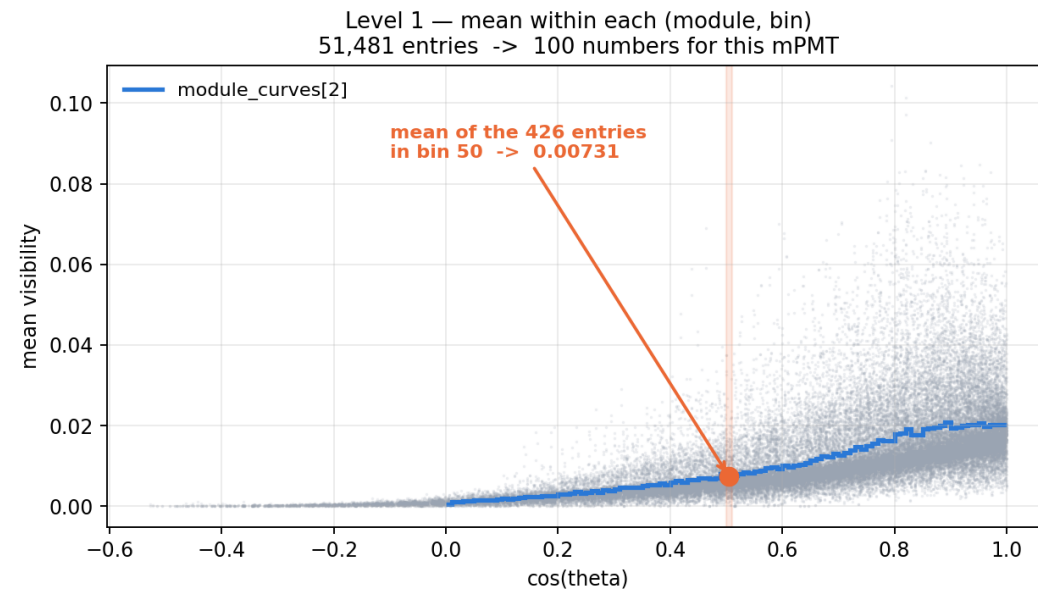
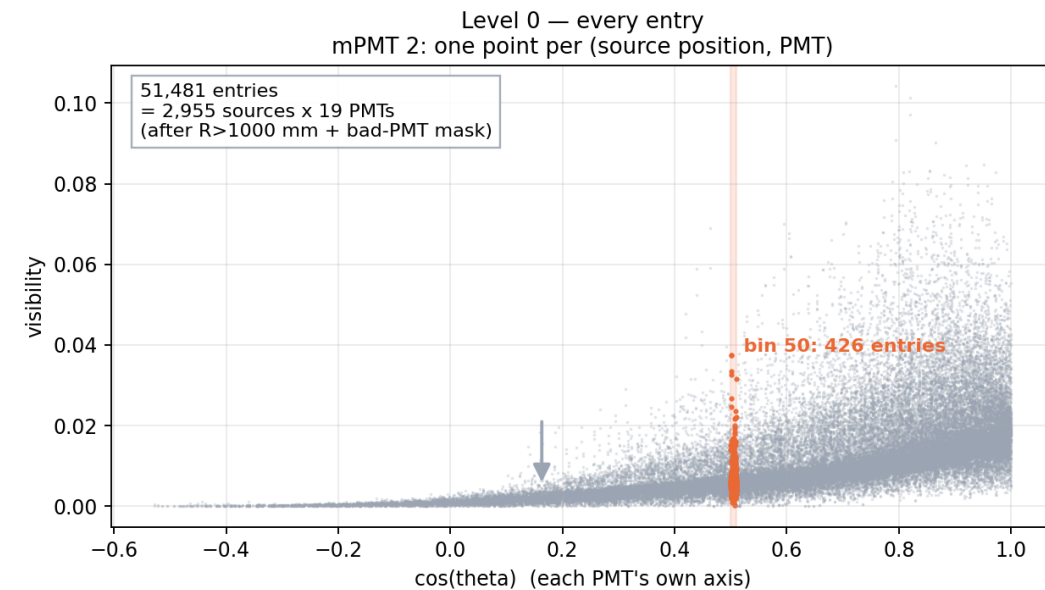
B — one z-plane ($z = 0$ mm), viewed from above
17x17 square lattice, clipped to $r \leq 1500$ mm $\rightarrow$ 197 points



C — side view (x-z projection)
15 z-planes; mPMTs sit just outside the source volume



How the angular response is averaged — four nested means



The ratio $\text{posttune}/\text{pretune}$ is formed at Level 2 (bin by bin); the Level 3 scalar is the per-mPMT correction factor written to `per_mpmt_efficiency*.npz`

Summary

- CosmicAnalysis (w/ fiTQun) computes the $Q \cdot R$ and make the histogram of $(\cos\theta, \langle Q \cdot R \rangle)$, then the ratio is data/MC
- OpticSiren sample the point light source uniformly in the tank and make the histogram of $(\cos\theta, \langle \text{visibility} \rangle)$, the ratio is posttune/pretune
- The two methods are very different and may be not reasonable to compare
- Todo (Will try to complete them by the end of this week)
 - Plot the different PMT groups into different regions to check for consistent patterns across groups.
 - Prepare the draft slides for WCTE meeting