SIREN PMT Angular Response with WCTE Cosmic data

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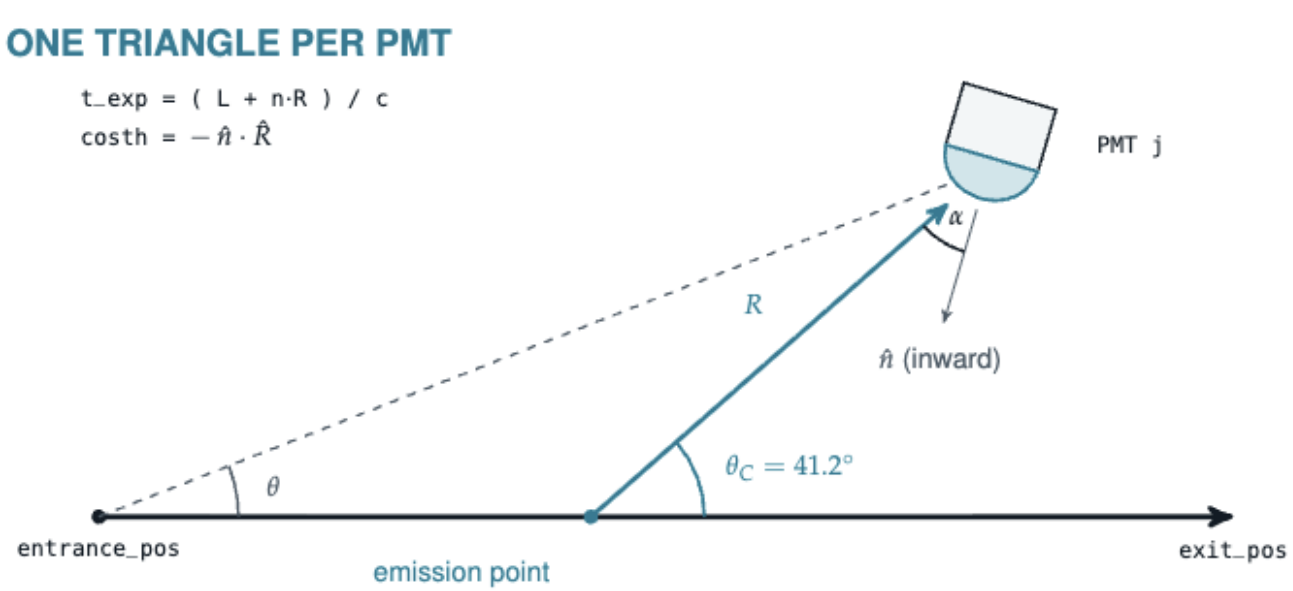
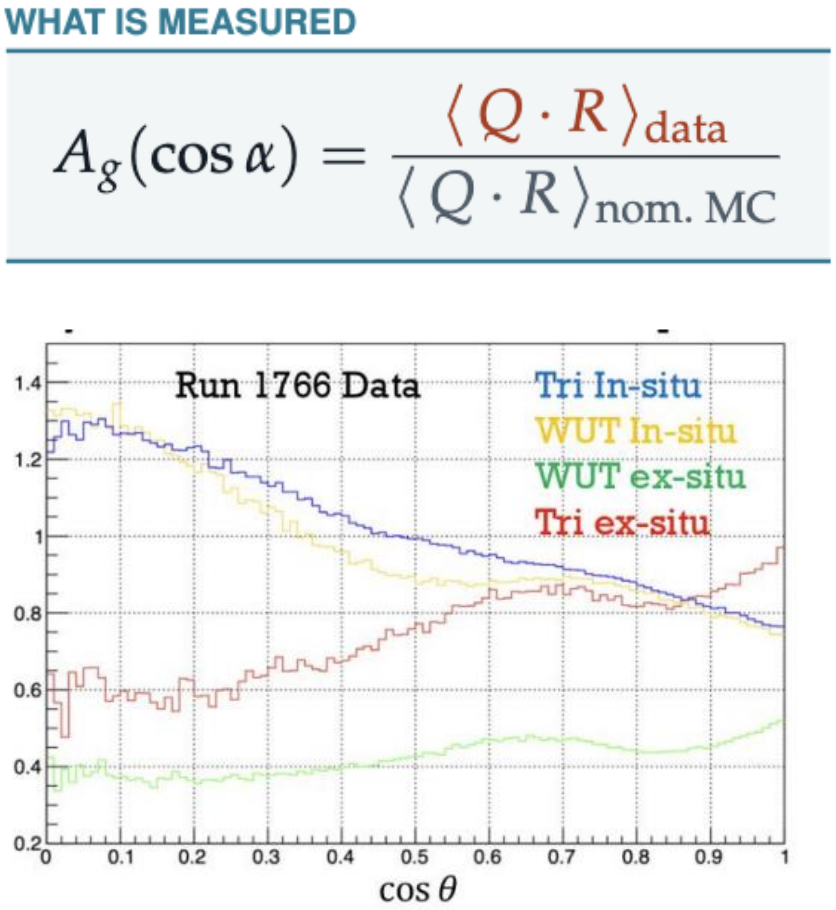
Angular Response in CosmicAnalysis (w/ fiTQun)



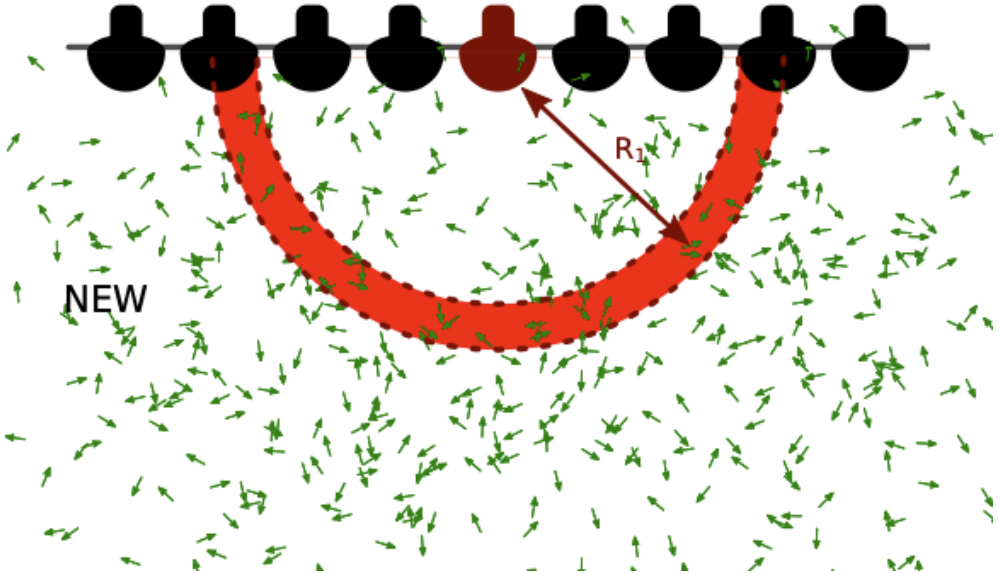
The Cherenkov angle fixes where on the track the light that reaches PMT j was emitted — and therefore its expected arrival time, its path length R, and the angle α at which it strikes the PMT face.



Angular Response in OpticSiren

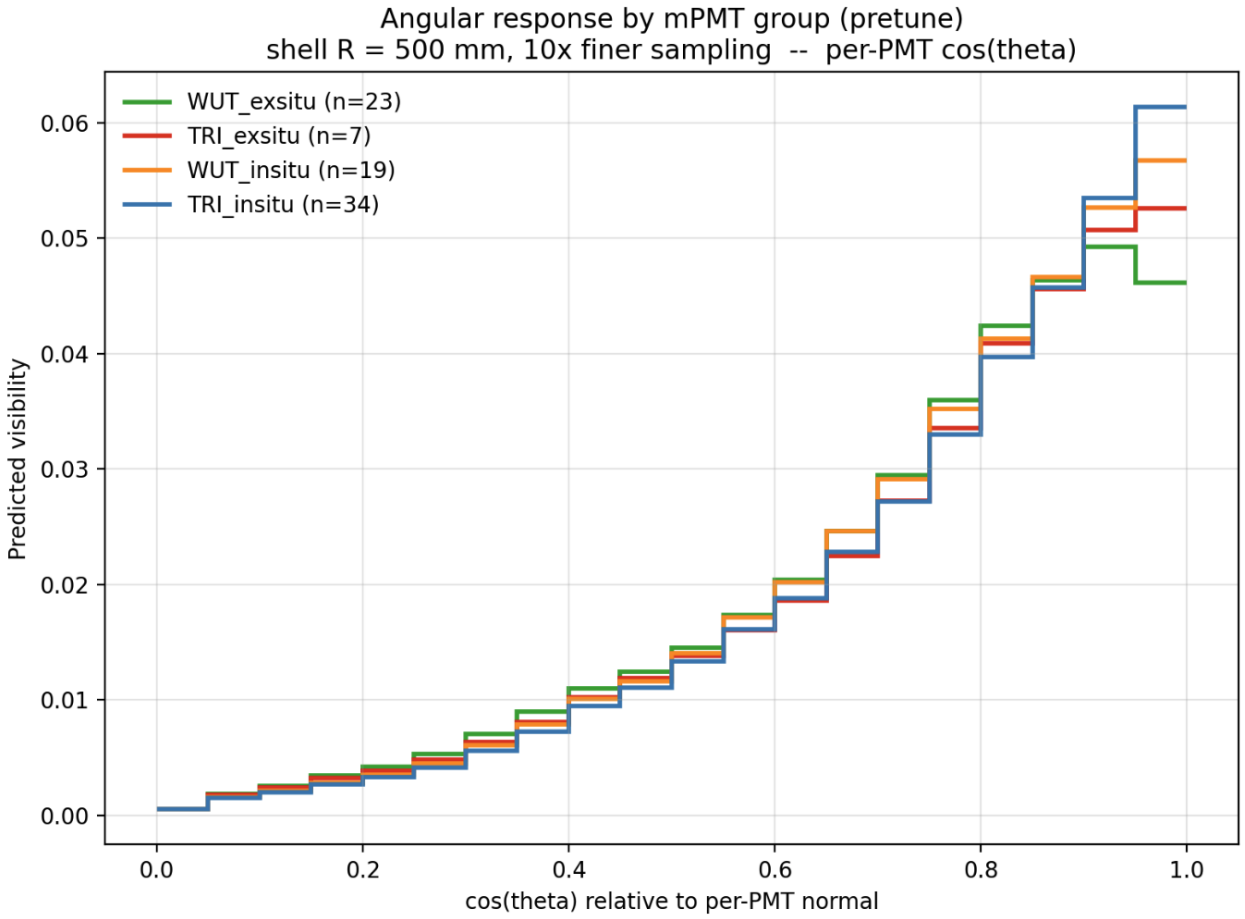
There are two Siren model trained:
Pre-tune: trained by photon shotgun
Post-tune: calibrated by WCTE cosmic data

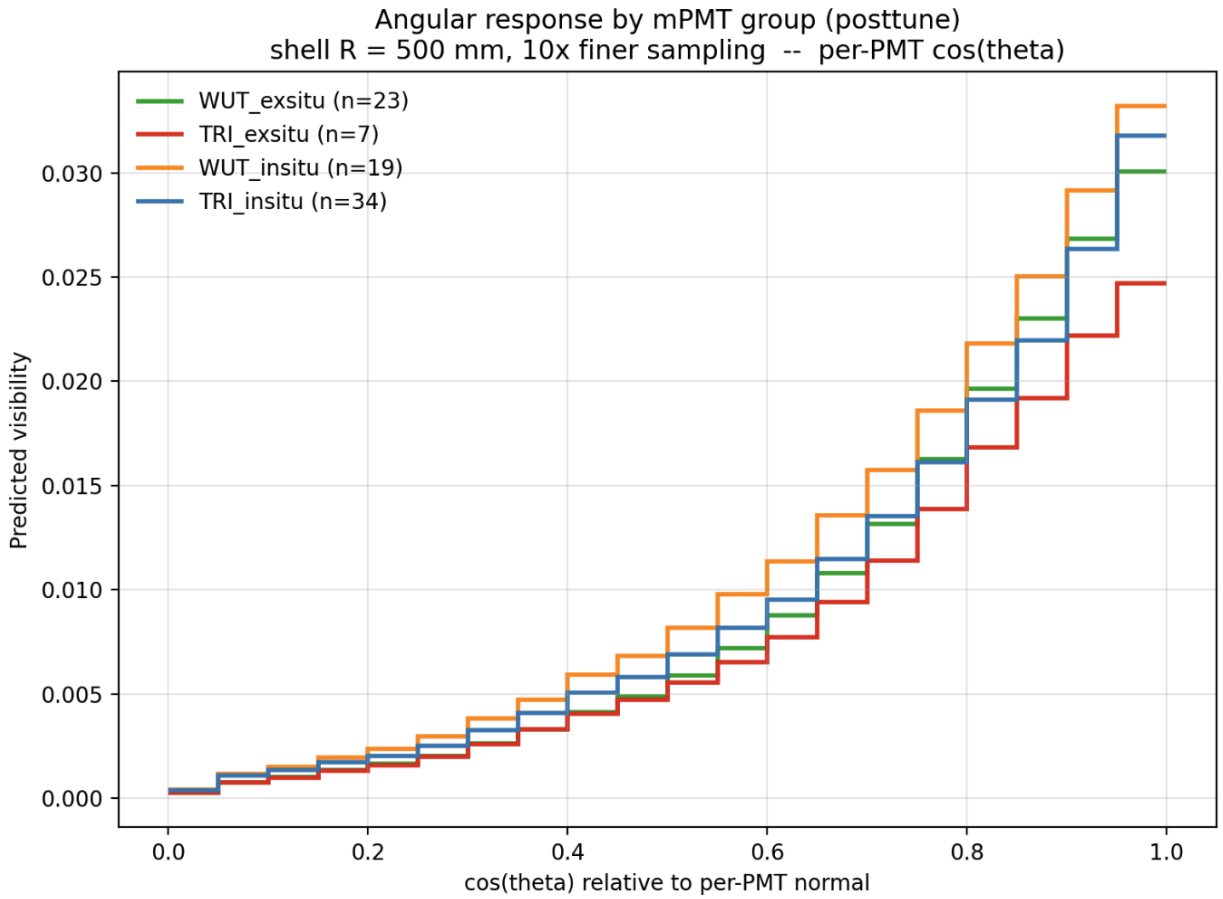
The angular response is extracted from a GEANT4-based MC of 3 MeV electrons distributed uniformly within the tank volume (photon shotgun). For each event, PMT hits falling on a shell of radius R are collected, and the resulting hit probability is parameterized as a function of the photon incidence angle cos θ.



Idea of use OpticSiren to do the WCTE mPMT angular response calibration:
Change the **GEANT4**-base simulation to **SIREN**

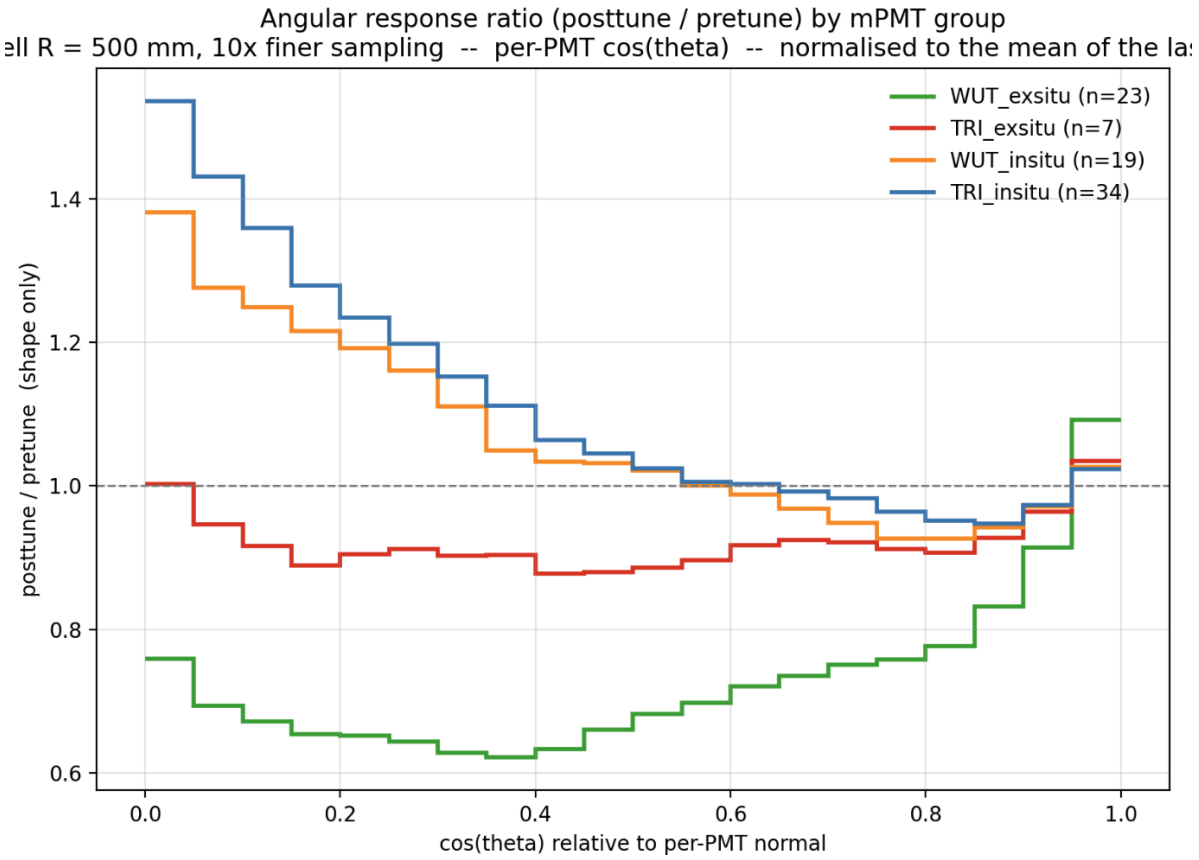
OpticSiren Angular Response



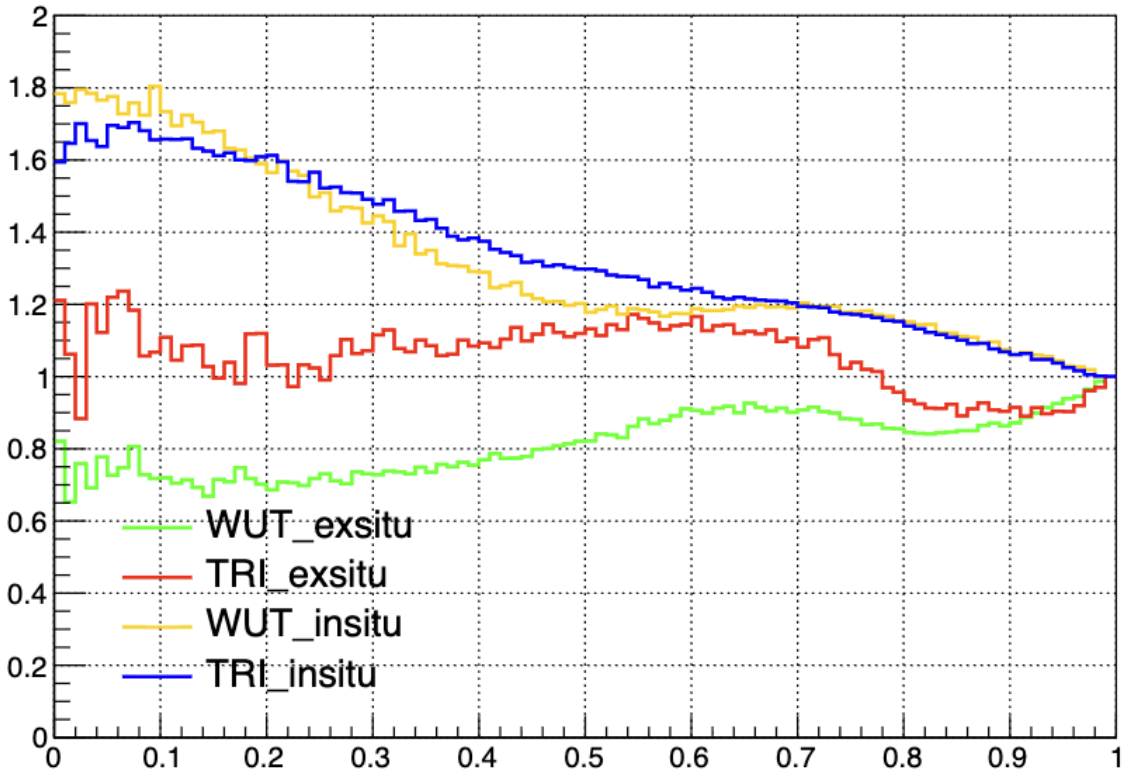


Post-tune/pre-tune angular response ratio

OpticSiren
(normalized last 2 bins)

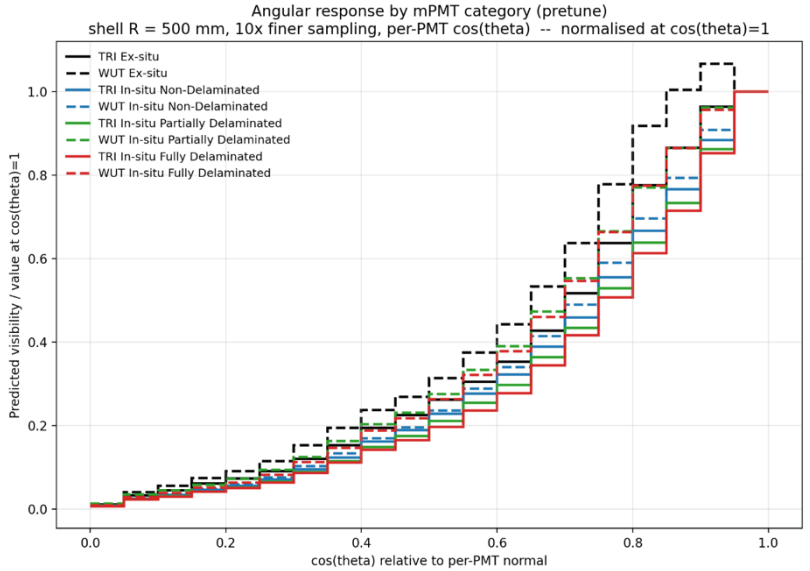


CosmicAnalysis
data/MC
(normalized last bin to 1)

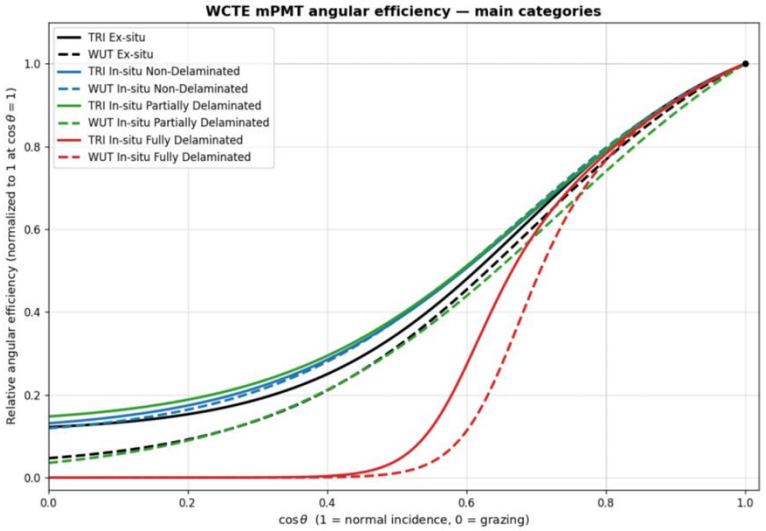


Group the mPMT by delaminated or not

SIREN pre-tune PMT Angular Response

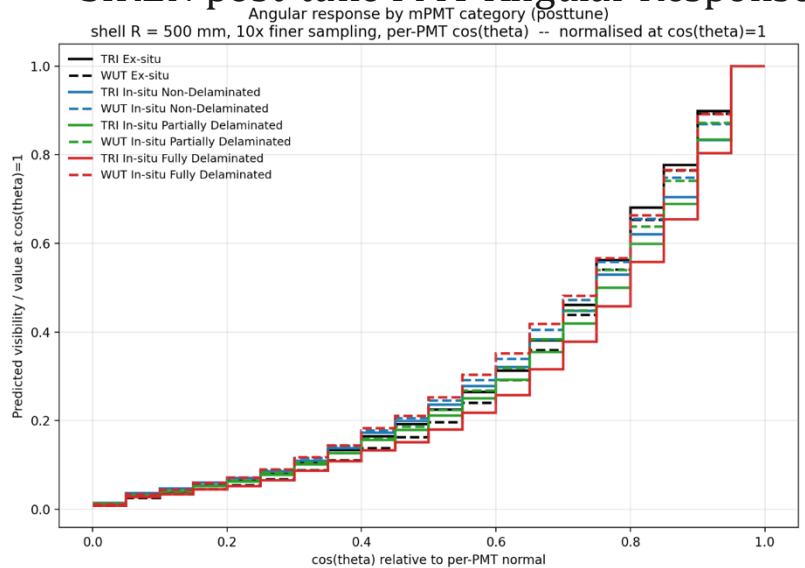


PMT Angular Response from Diffuse LEDs

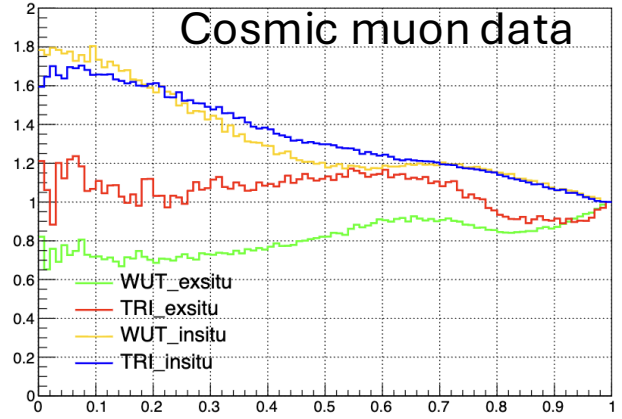


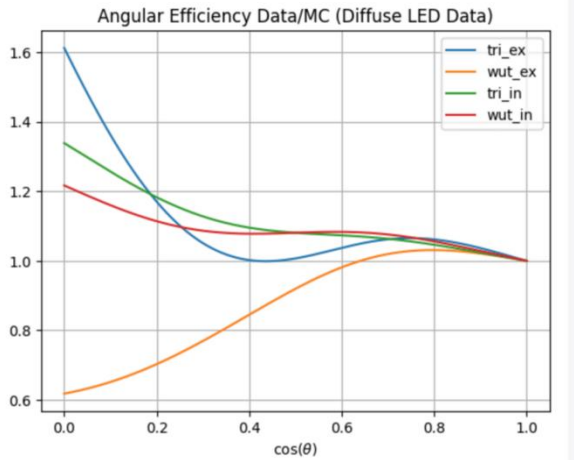
Partially delaminated = less than 90% of mPMT is delaminated
Fully delaminated = more than 90% of mPMT is delaminated

SIREN post-tune PMT Angular Response

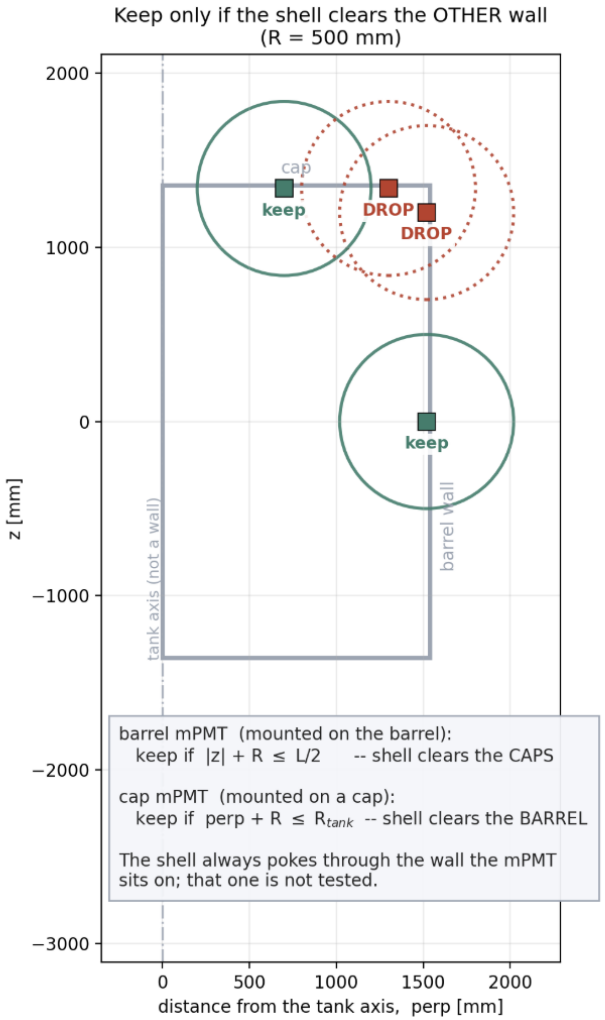


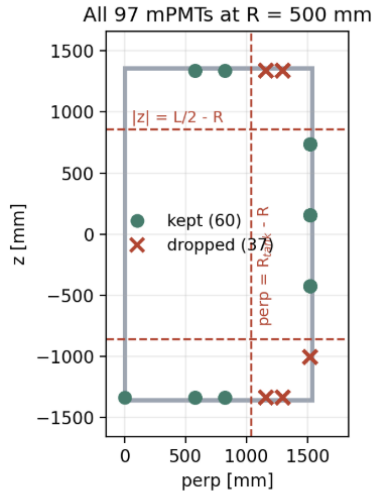
Maybe it's not comparable for the two angular responses cause the data/MC are different between Cosmic muon data and diffuse LED data

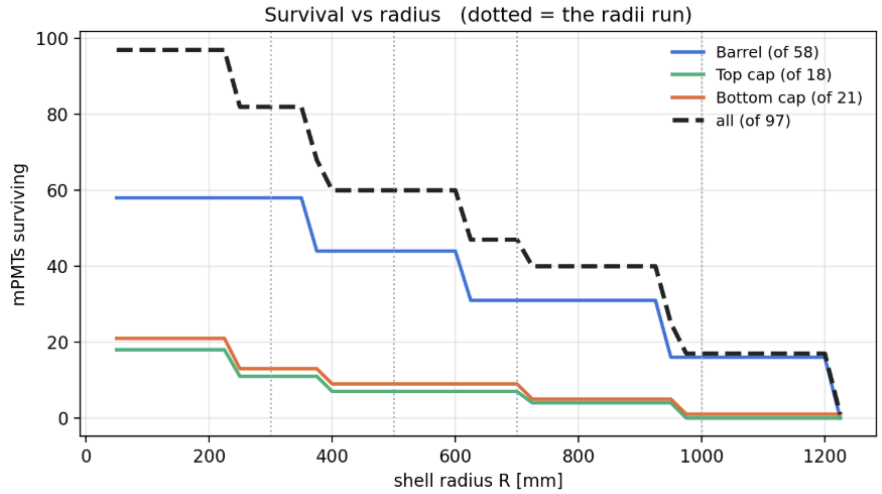




Exclude the mPMTs of which the shell reaches the boundary







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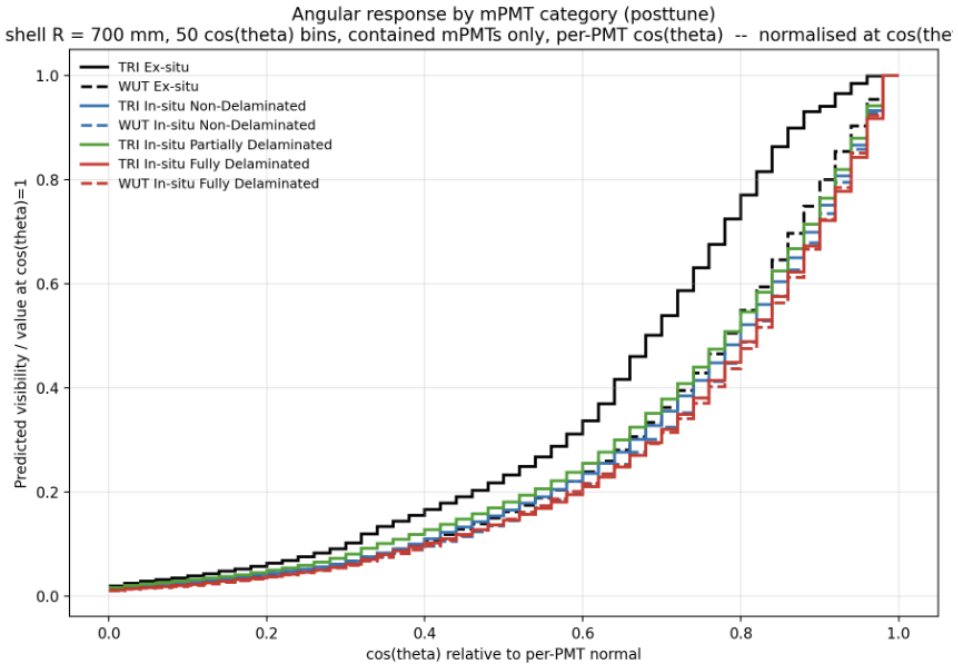
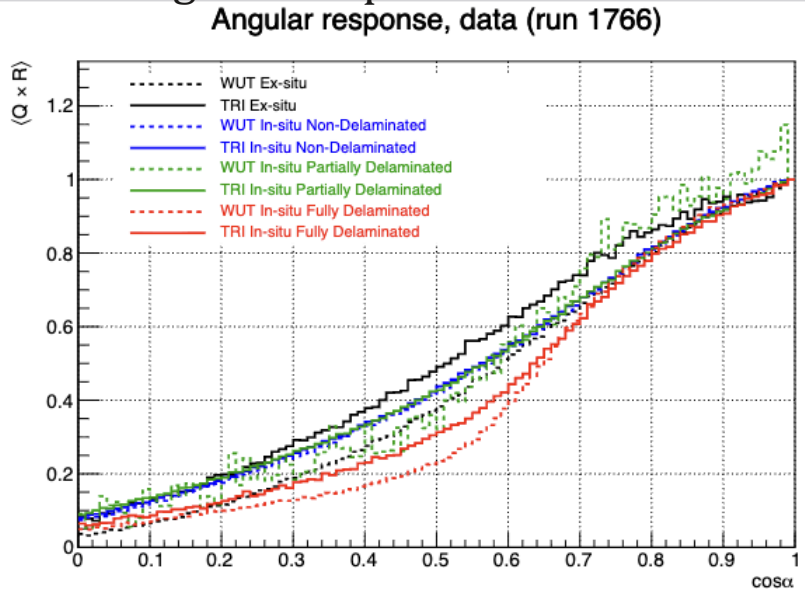
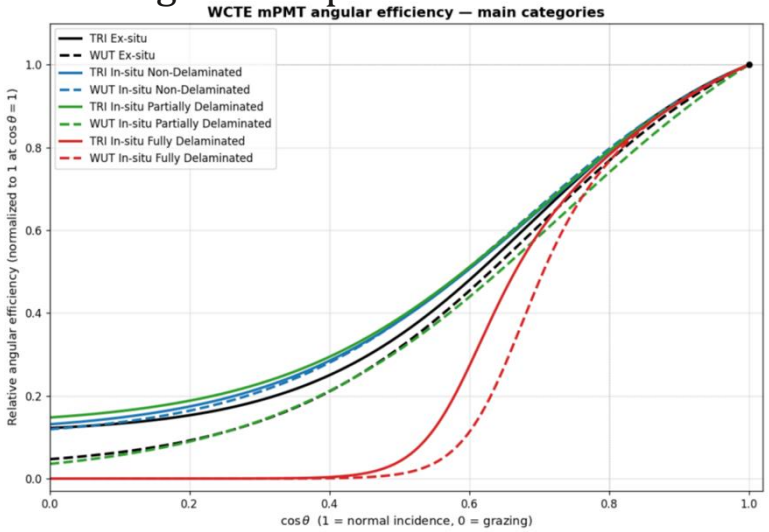


SIREN

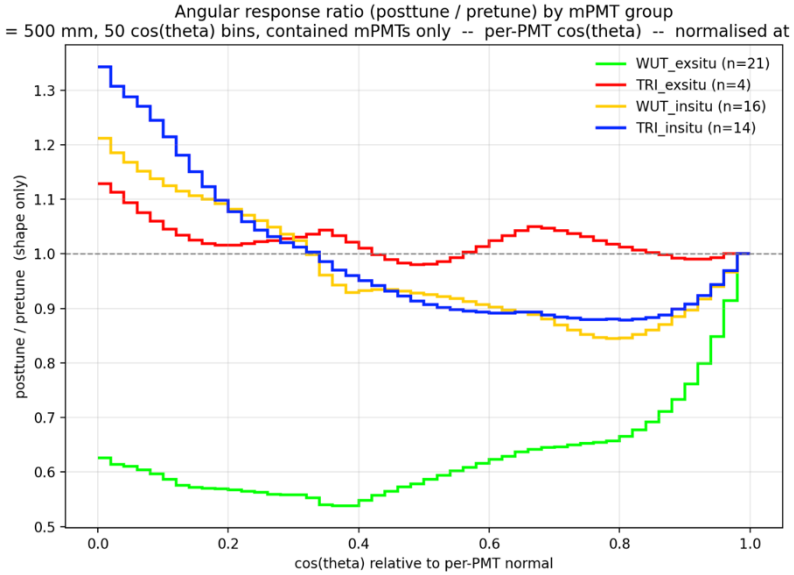
PMT Angular Response from CosmicAnalysis



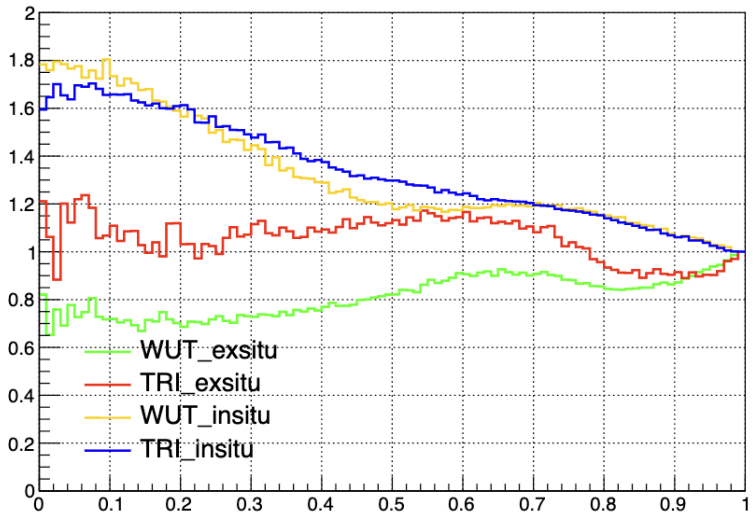
PMT Angular Response from Diffuse LEDs



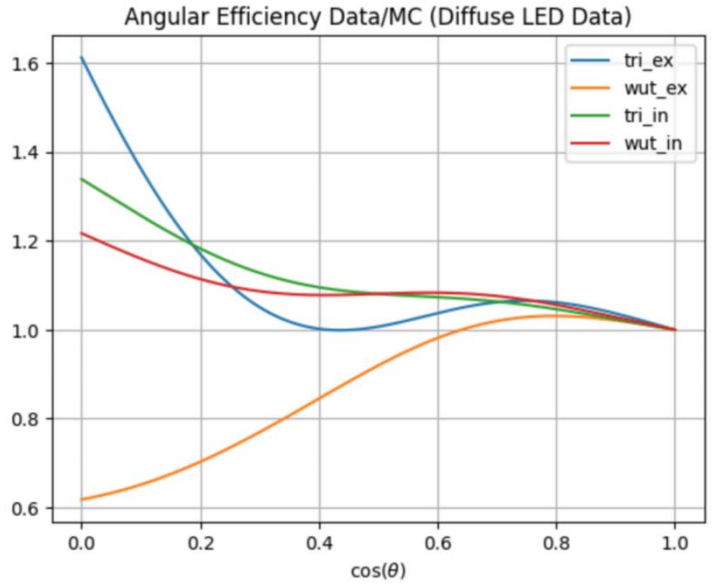
Updated OpticSiren Angular Response



SIREN



CosmicAnalysis



Diffuse LEDs

Summary

- Instead of uniformly sample the point light source in the tank, sample from a shell of radius of 500mm and make the angular response. Now the post-tune/pre-tune (data/MC) is similar with Ka Ming's study

- Separated out the mPMTs to delaminated
  - Not really agree with the diffused LED angular response – the fully delaminated mPMTs show obvious different response
  - The CosmicAnalysis response (w/ fiTQun reco) is not sensitive to the delamination either
  - If exclude the mPMTs of which the shell reaches the boundary of the tank, the response is closer with CosmicAnalysis

- Reconstruction for beam data is ongoing