FDIRC MC Studies: PMT Coupling Options

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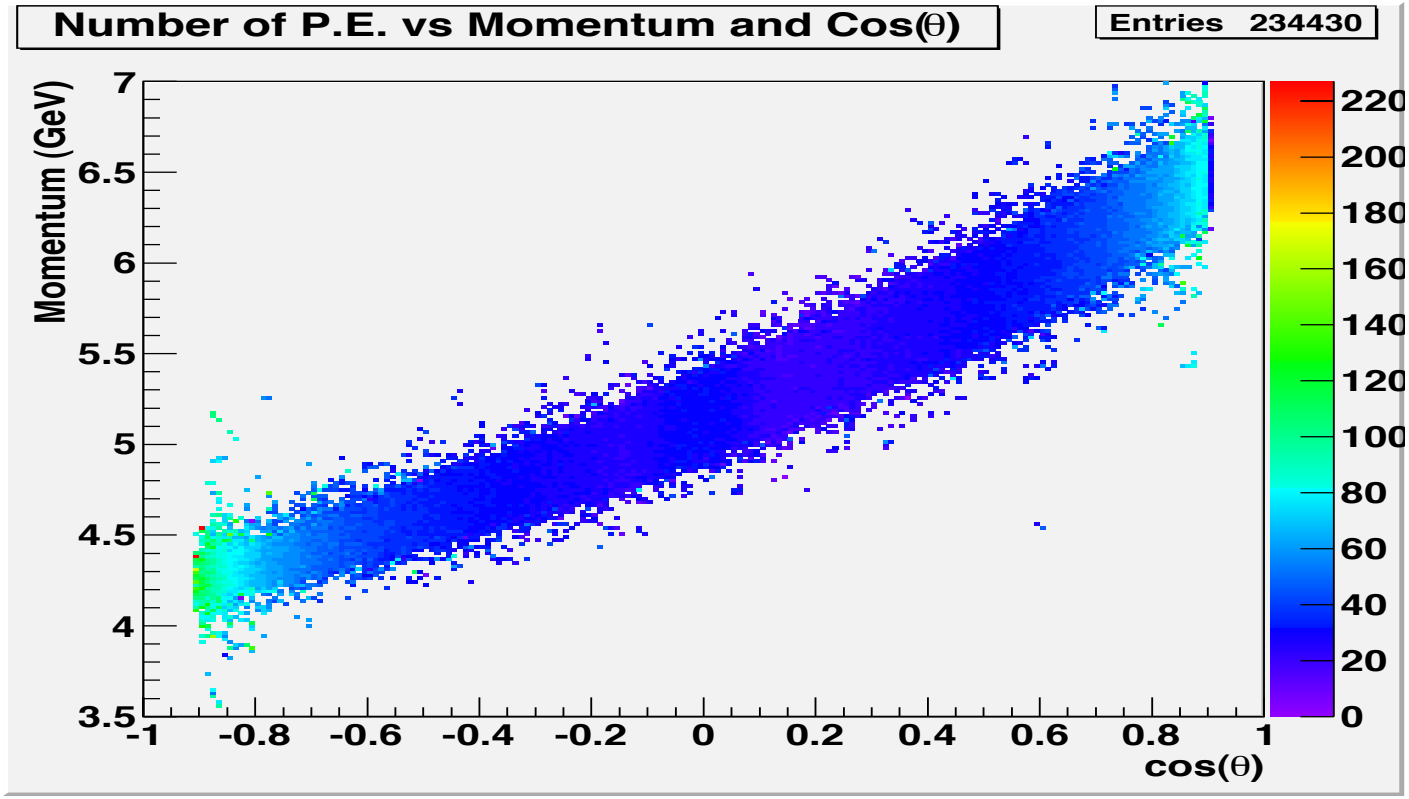
Overview

- Want to study the effect of PMT coupling options to the Focusing Block
  - Either just Air
  - Or some type of optical coupling
- Just air would make PMT removal much easier
- But, we would lose some photons incident to the PMT face at larger angles do to index mismatch
- How big of an effect is this on the resolution?

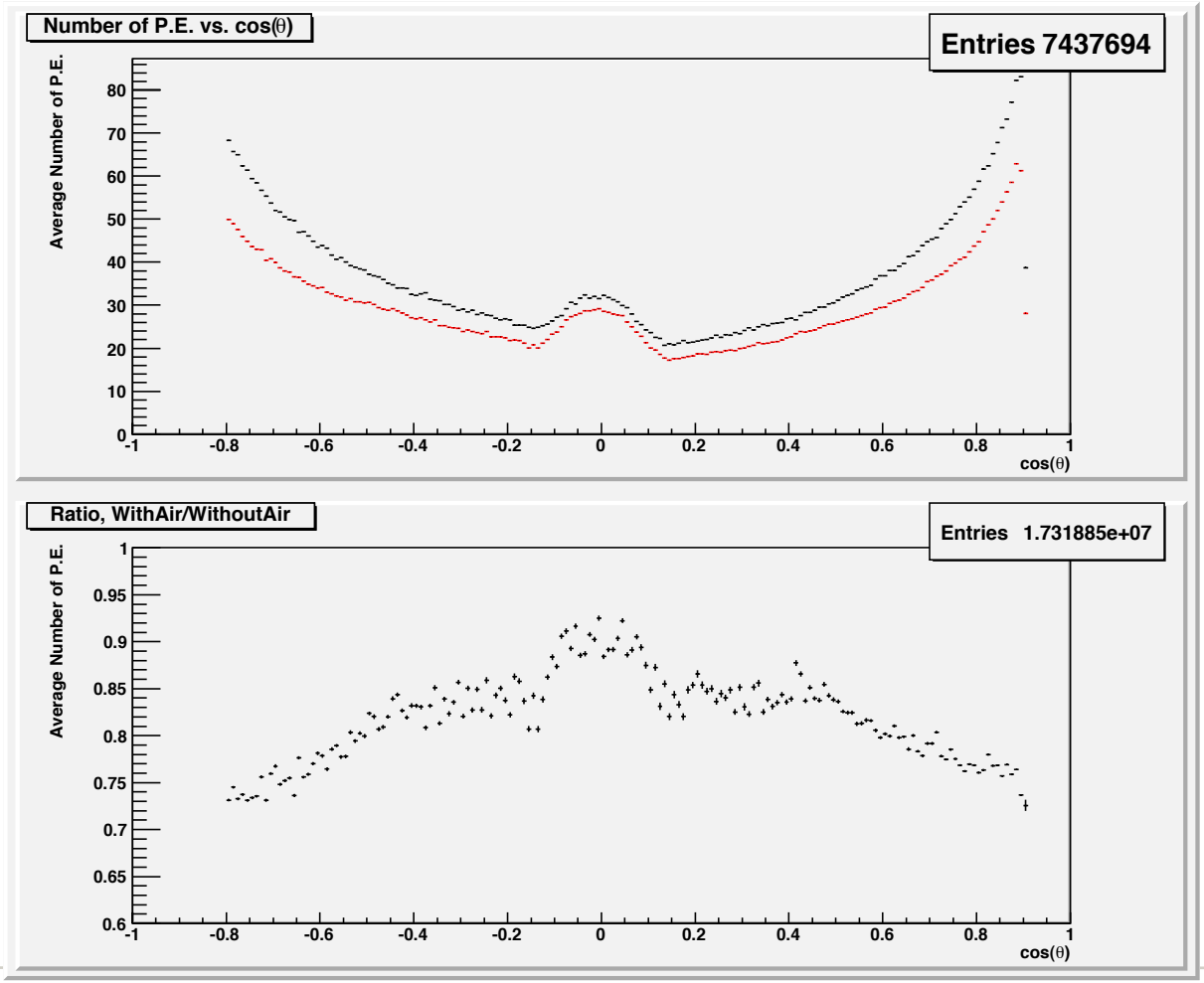


Studied with di-muon tracks

High momentum muons, generated over all dip angles
Full barrel detector simulation with magnetic field on
Hamamatsu H8500, 12 mm x 6 mm pixels

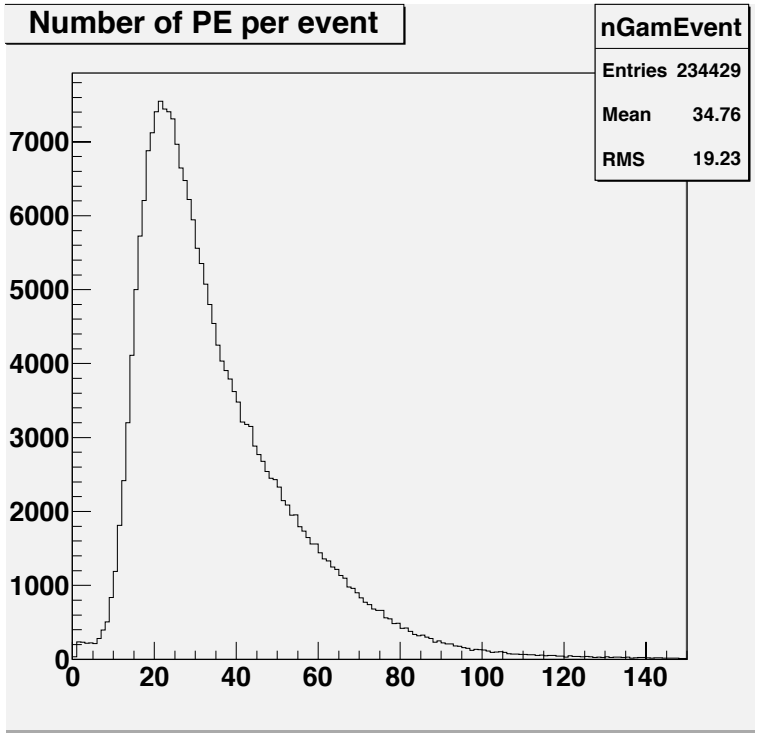
Photoelectrons vs. cosθ

On average, a ~20% loss of photons

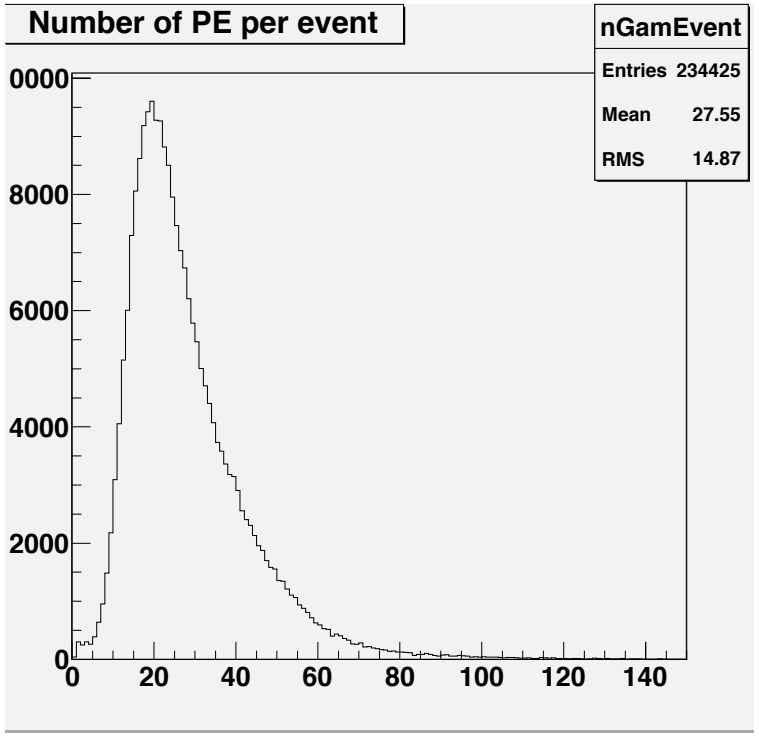


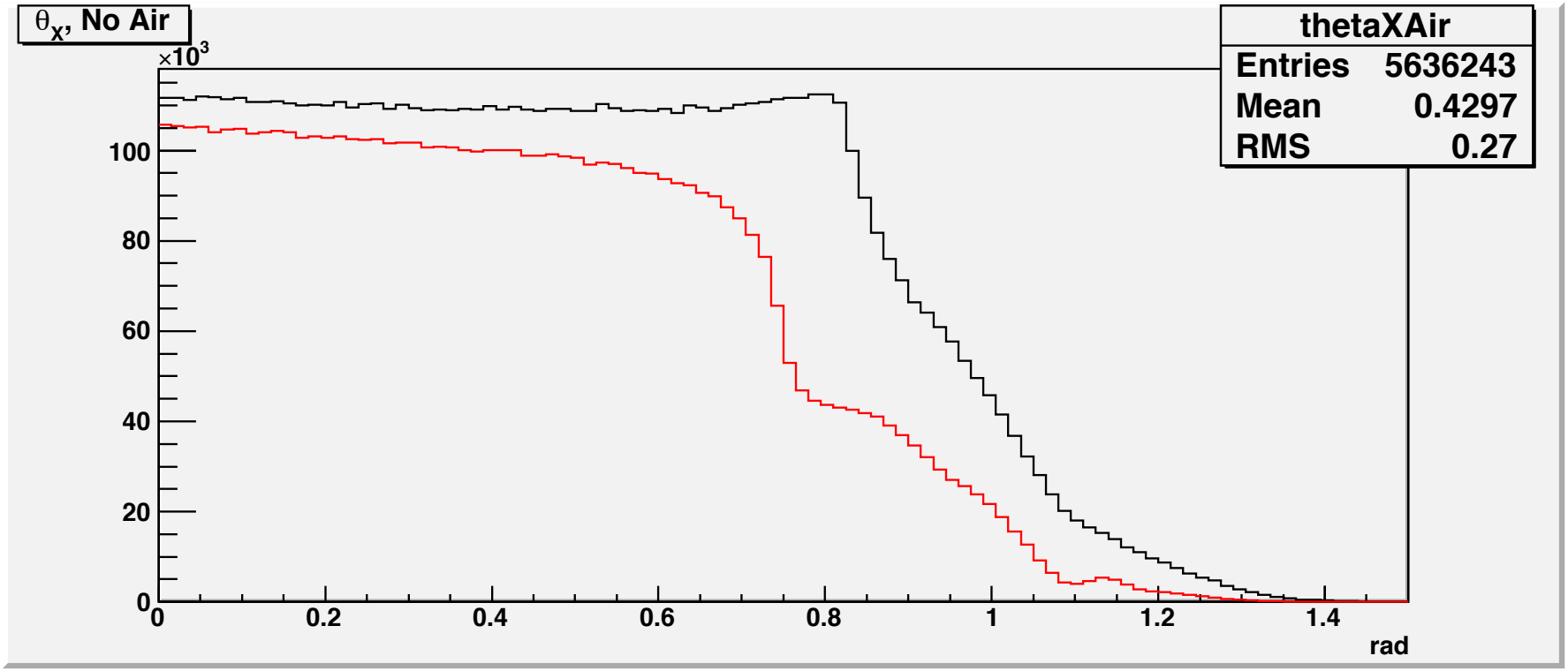
Photoelectrons per Event

No Air Gap
$<N_{PE}> = 35$



With Air Gap
$<N_{PE}> = 28$



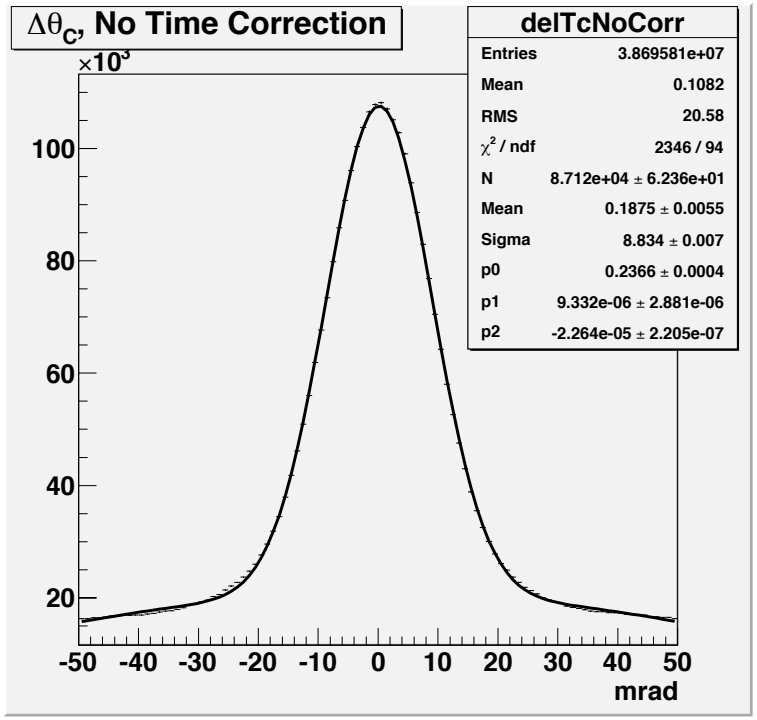


Compare θ_X as photon leaves bar

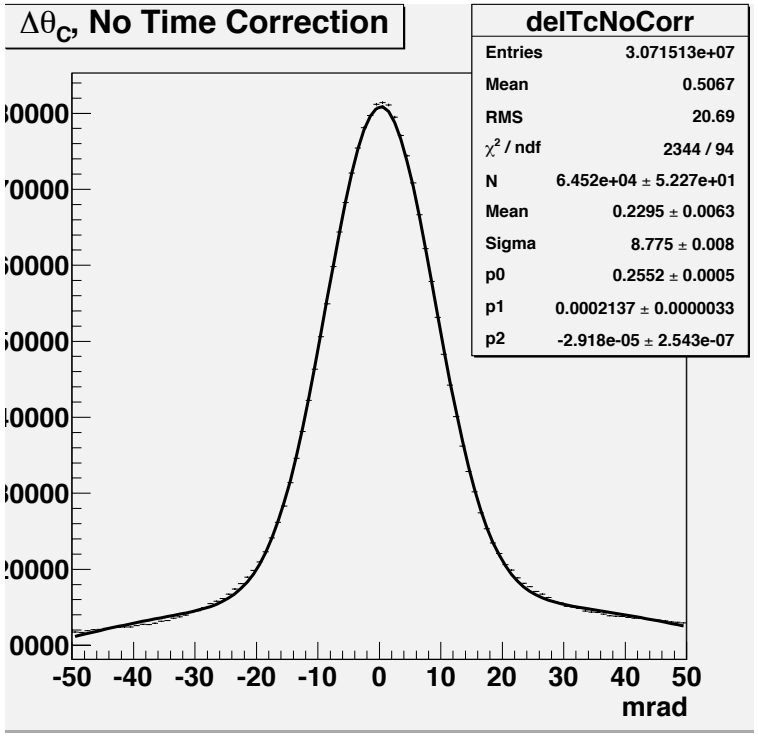
Black = no air gap
Red = air gap
Actual angle at focal plane also a function of θY

Single γ θ_C Resolution

No Air Gap
σ = 8.834 mrad



With Air Gap
σ = 8.775 mrad

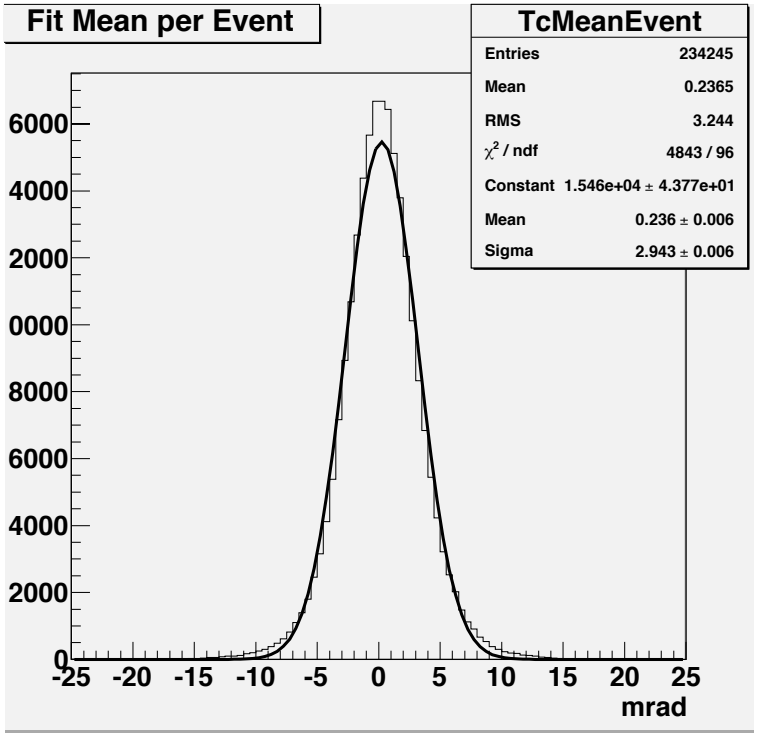


Event Resolutions

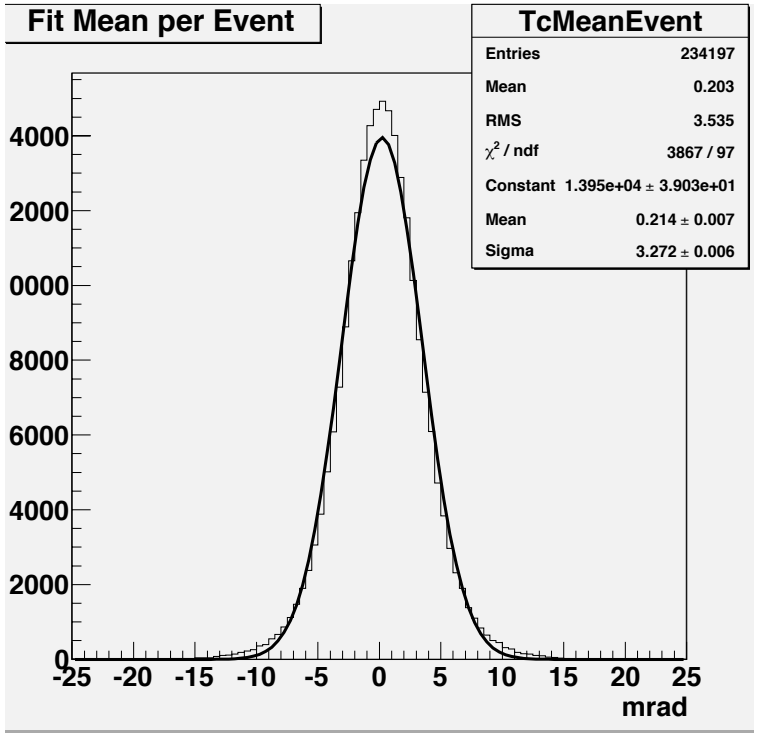
- What really matters is the single event resolution
- This is where losing photons will be seen
- Technique: Take θ_C measurements for all photons in an event and fit to the profile of the single γ θ_C resolution with everything fixed except the mean and normalization
- Probably not the optimal way to extract θ_C, but ok for comparison?

Event θ_C Resolution

No Air Gap
σ = 2.94 mrad



With Air Gap
σ = 3.27 mrad



Conclusion

- There will be a degradation of resolution with an air gap, roughly about ~10%.
  - Trade-off with mechanical convenience
- In both cases, things can be improved with timing/ chromatic correction
- Analysis technique is probably non-optimal:
  - Single photon resolution looks better than BaBar
  - But single event resolution is a bit worse
    - Blame analysis, I think