

Theia reconstruction update

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fiTQun reconstruction status

- To enable the fiTQun in WbLS, the plan is to do water Cherenkov reconstruction, and then add the scintillator light in.
- Demonstrate fiTQun in BNL 30T geometry(also enabled the tuning with BNL30T), the reconstruction(ratpac-2 MC, 30T tuning*) works but the PID always prefers electron-like
- To figure out the PID reconstruction, the plan is to demonstrate fiTQun with the ratpac-2 simulated Hyper-K(pure water, large cylinder tank) MC, and validate with WCSim (official Hyper-K simulation tool) + fiTQun.
- Start from the direct light-only, charge-only reconstruction. Now using ratpac-2 generating Hyper-K MC with direct light only

* 30T tuning: tuning with 30T geometry for angular, charge PDF, scattering table, but with WCSim Cherenkov profile & time PDF because generating MC for these two tuning part is very time consuming

Validation between WCSim & ratpac-2

- Used to discover a ~40% decrease in WCSim p.e. -> digitized charge (unit in p.e., this is what is read in in fiTQun)

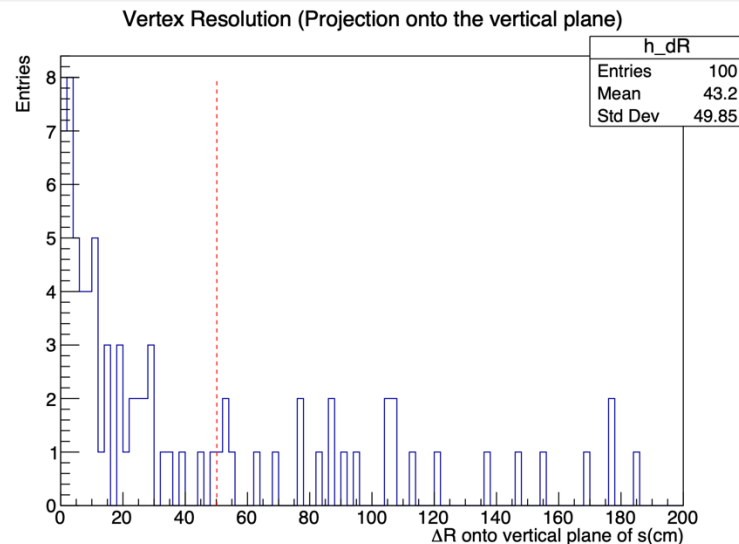
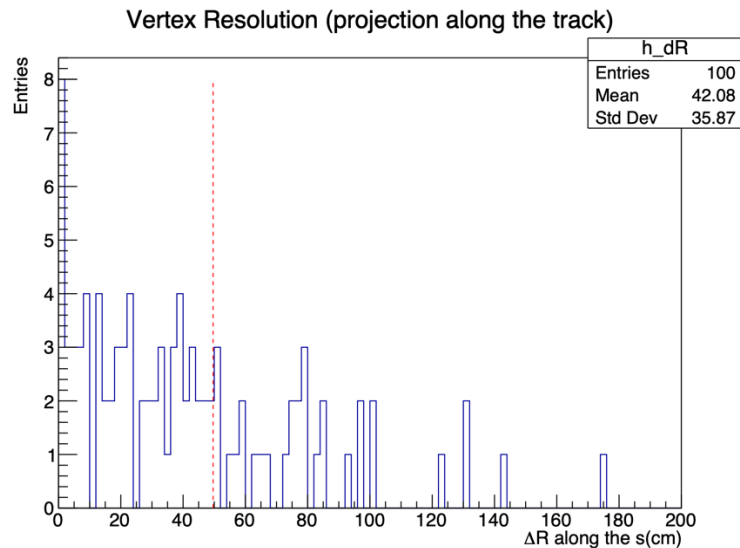
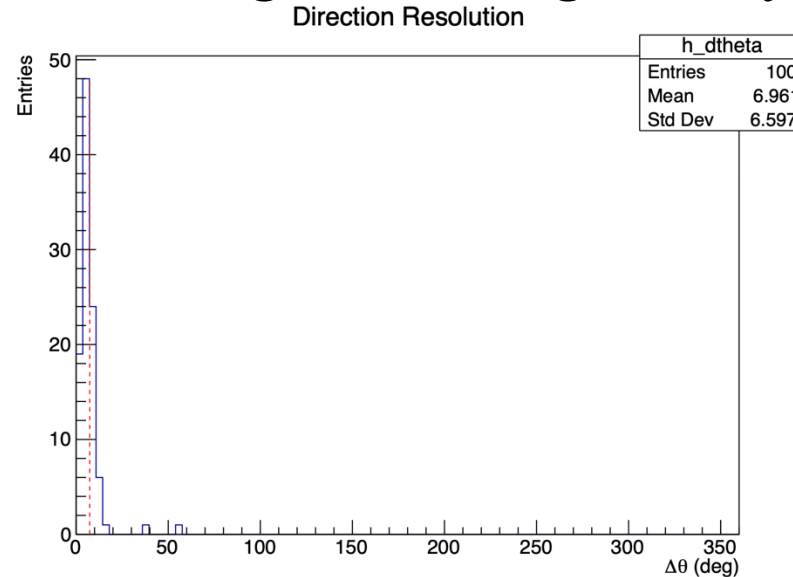
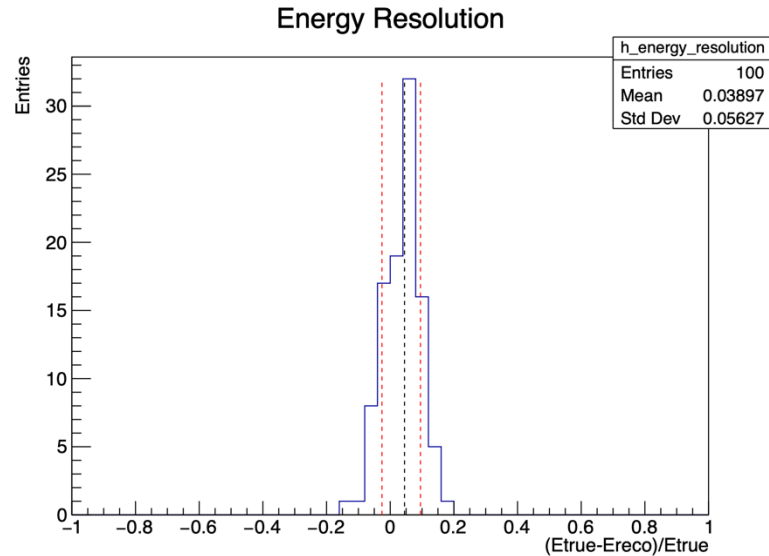
	WCSim	Ratpac-two
1M optic photons (isotropic)	6.03%	5.87%
100MeV electron (fix pos&dir, 100evts)	P.E. hit: 1,229; digitized charge: 523 p.e.	P.E. hit 904
1000MeV electron(fix pos&dir, 100evts)	P.E. hit: 8,400; Digitized charge: 5,467 p.e.	P.E. hit 9,000

- The difference is from the **dark rate**, after set the dark rate to 0, the difference between P.E hit and digitized charge are not very large (~O(10) p.e. decrease)

Update from fiTQun

- Fix a bug which cause the prefix vertex going to wrong position
 - In fiTQun the time window was set to (900,1400) ns (which is a Super-K time offset), and the pre-fit algorithm use this window to pre-fit the vertex via the PMT time information.
- Generated the ratpac-2 MC with the direct light only, Hyper-K geometry to exclude the effect from the scattering & reflection

fiTQun reconstruction result (ratpac-2 HK MC, WCSim tuning, direct light only, charge PDF only)



True: 100MeV electron

Fix vertex(0,0,0) and direction(1,0,0)

Energy resolution 68% interval: -
0.0258824 – 0.095, width $\approx$
0.0604412, mean: 0.045

Vertex resolution 68% interval: 151.04
cm.

Vertex (along track) resolution 68%
interval: 49.64 cm.

Vertex (vertical) resolution 68%
interval: 50.16 cm.

Direction resolution 68% interval: 7.35
deg.

Plans

- The validation of reconstructing ratpac-2 MC is ongoing, with Hyper-K geometry
 - After bug fixing, the fiTQun reconstruction of direct light only, charge only works with ratpac-2 MC
 - Will add the digitized charge (same smearing as WCSim) to replace the P.E. in MC
 - Will double check with random energy, vertex, and different PID. Additionally, will add the scattering and time information in the reconstruction after confirming the direct light only reconstruction works well.
 - Will conduct the tuning with ratpac-2 MC in Hyper-K geometry and replace the WCSim tuning.
- After validating the fiTQun works with ratpac Hyper-K MC, will move on to adding the scintillator light in fiTQun.
- Parallely, will demonstrate the fiTQun with BNL30T as well.