Noise study update

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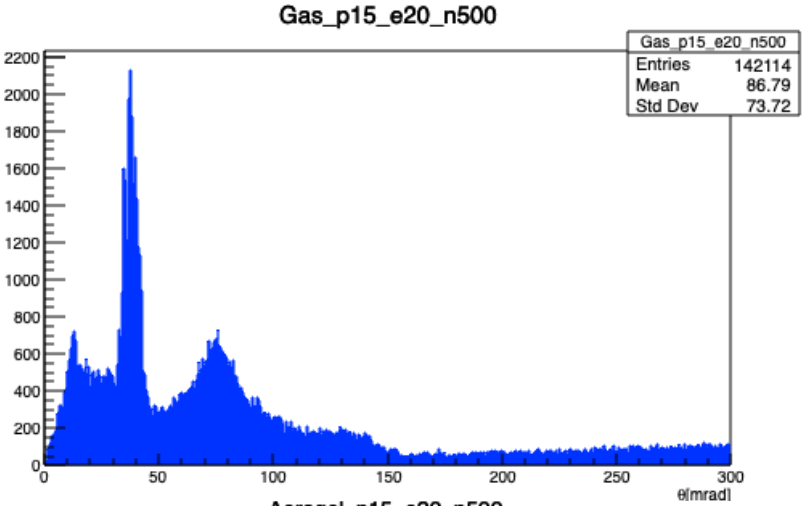
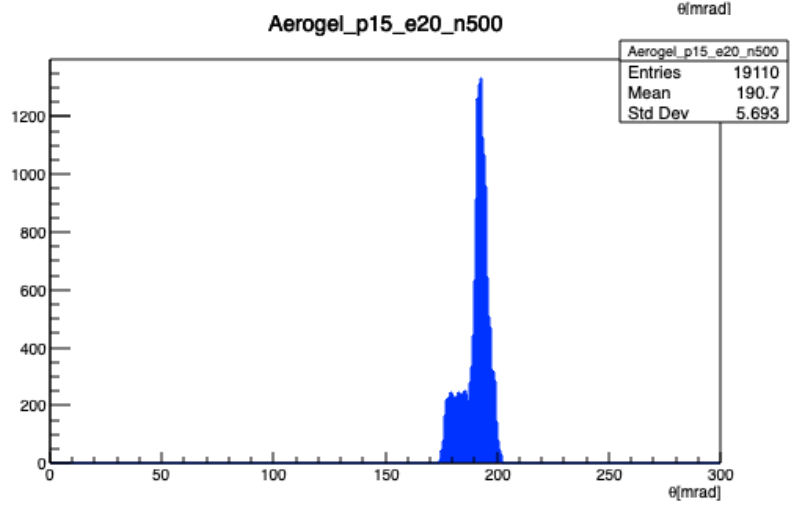
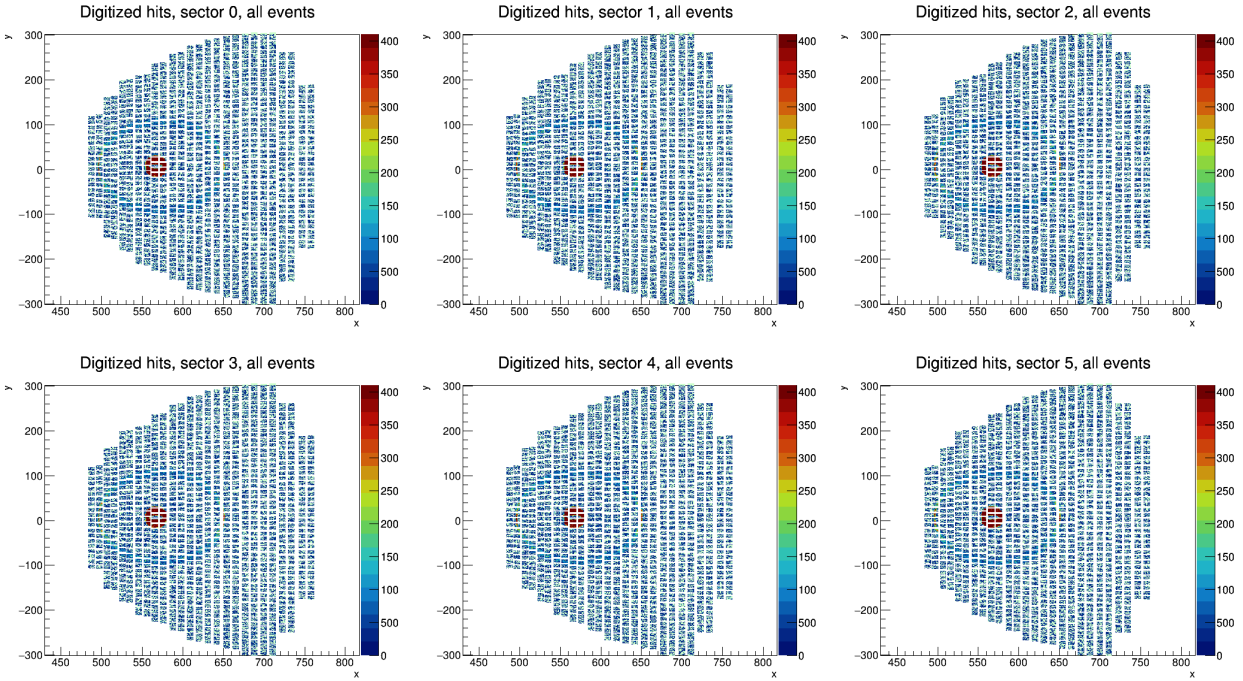
Situations before





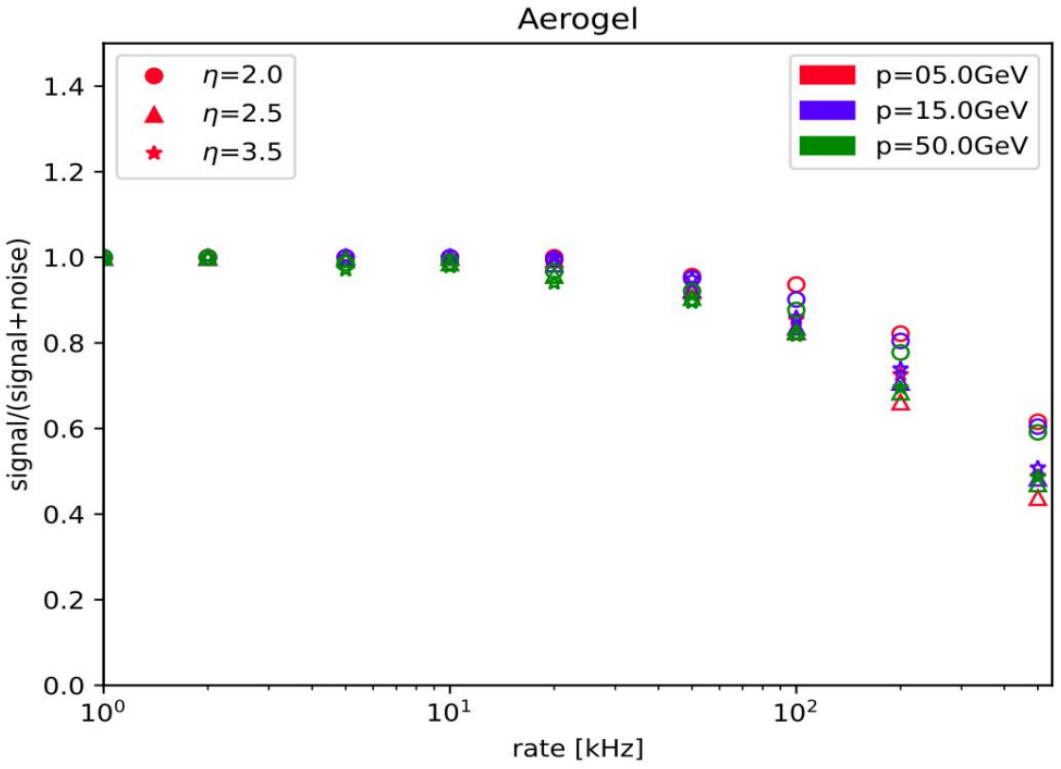
1. SPE theta distribution showed strange peaks.
2. Two different peculiarities in aerogel and gas reconstructed photons were observed.

Situations before



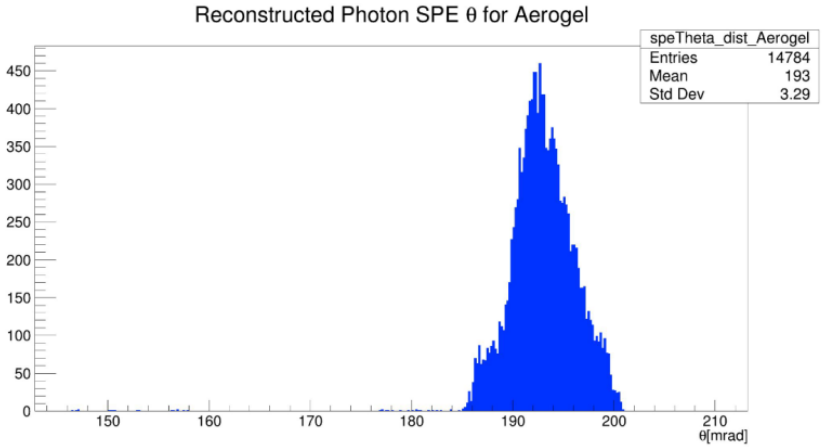
For a sector it looked the noise is uniformly distributed. Consistent to the injected noise.

Situations before

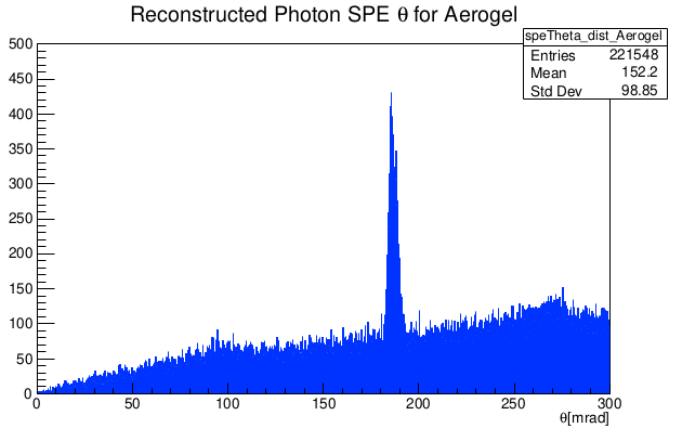


The noise under the peak appeared to be much larger than fraction expected from computation.

How EICRecon is selecting has a roleplay



Photons At least one mass hypothesis assigned



No photon selection based on mass hypothesis assigned

Still higher level of noise under peak!!

- Selection of photons based on at least one hypothesis assignment.
- Storage of all selected photons in 2D vector (theta, phi).
- If no photon selection is made aerogel side band appears (kaon under-threshold in gas).

Reported in ePIC Argonne workfest

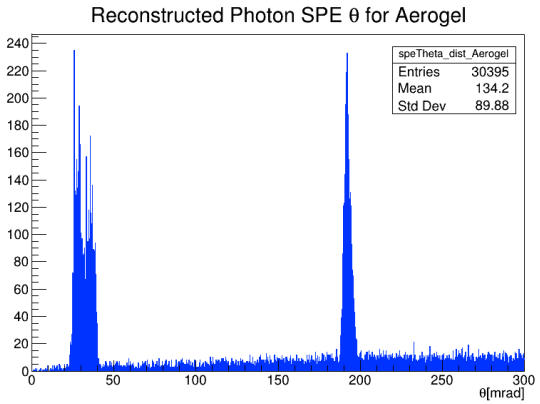
Effect of switching off nearby sectors

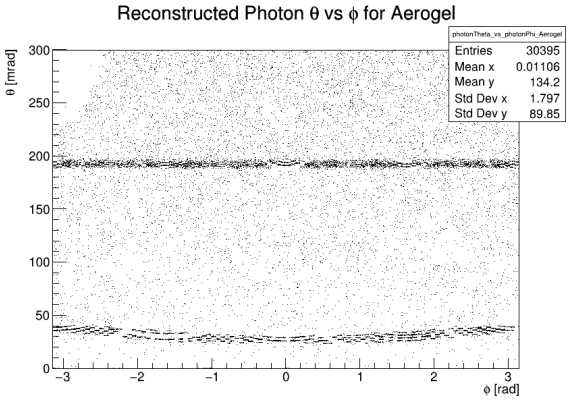
- IRT accumulates all photons and reconstructs.
- Noise hits from nearby sectors enhances the background contribution.
- Exercises made with switching off all nearby sectors and with single sector.

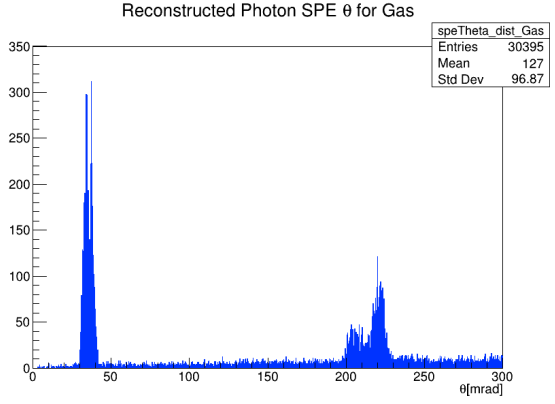
New studies

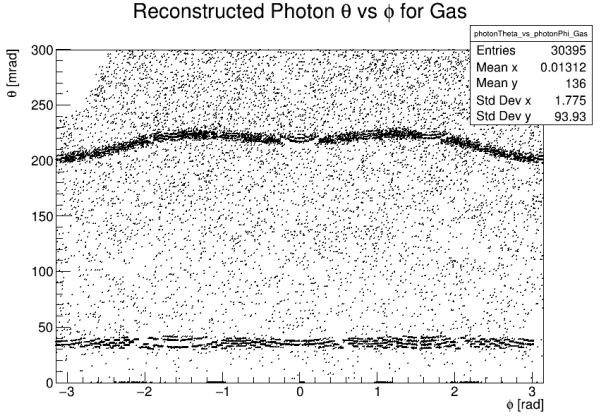
```
digi_cfg.noiseRate       = 500000; // [Hz]
digi_cfg.noiseTimeWindow = 1.0 * dd4hep::ns; // [ns]
```

30 GeV kaon at eta 2.0







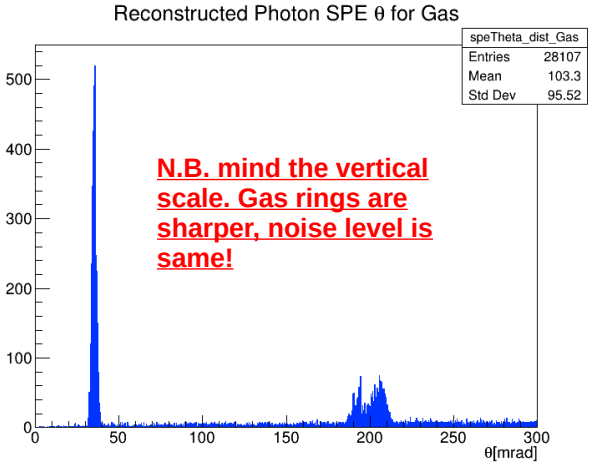


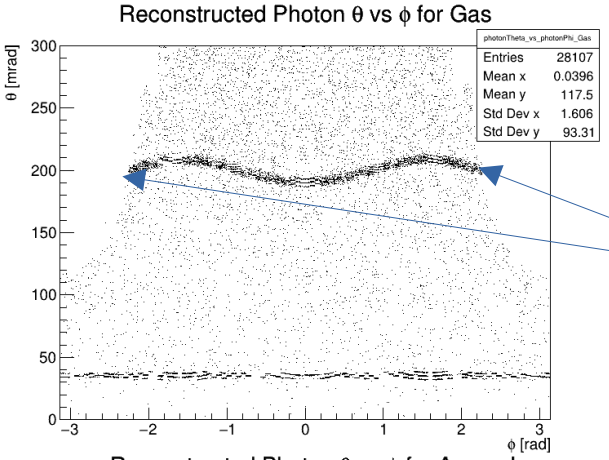
1. We have monotonic background. ✔
2. We see a sharp peak for aerogel
when we look for aerogel photons and
gas photons appear as background.✔
3. The gas background has strong dependencies on azimuth for aerogel photons and vice-versa. ✔

New studies

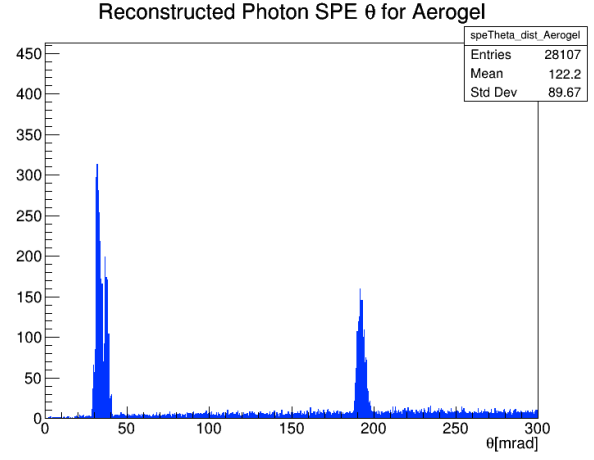
```
digi_cfg.noiseRate       = 500000; // [Hz]
digi_cfg.noiseTimeWindow = 1.0 * dd4hep::ns; // [ns]
```

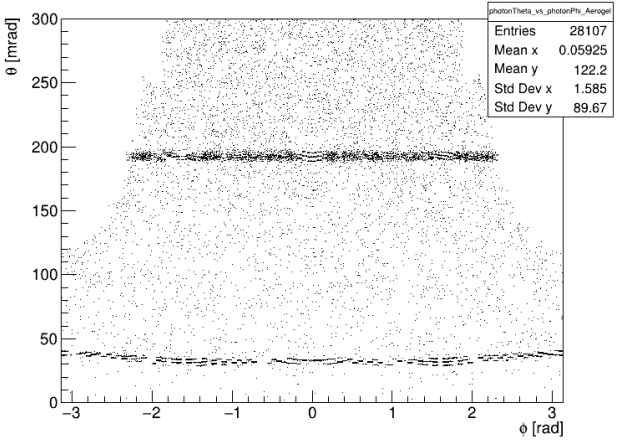
30 GeV kaon at eta 2.5





Lower fraction of aerogel photons are eaten by beam pipe.

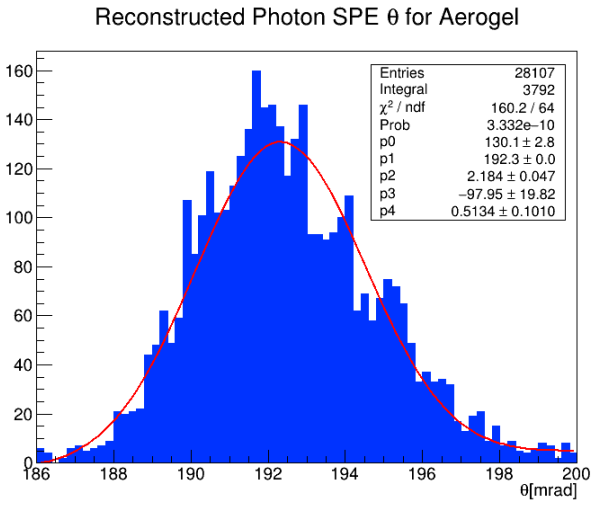




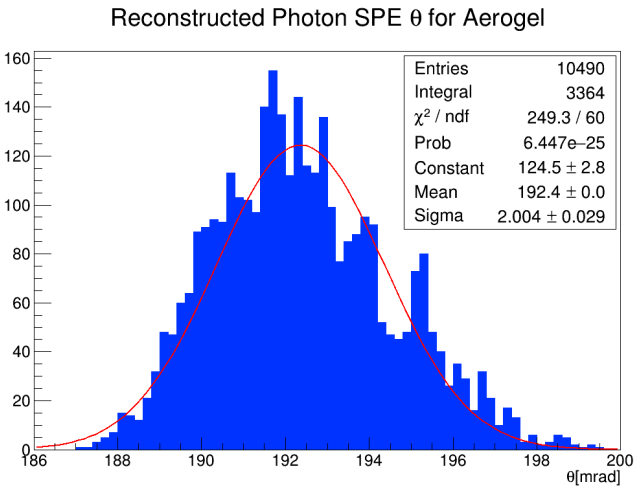
All of these images have been independently cross-checked by Tiziano!

Noise Fraction under peak

Dirty check!!



W/ Noise

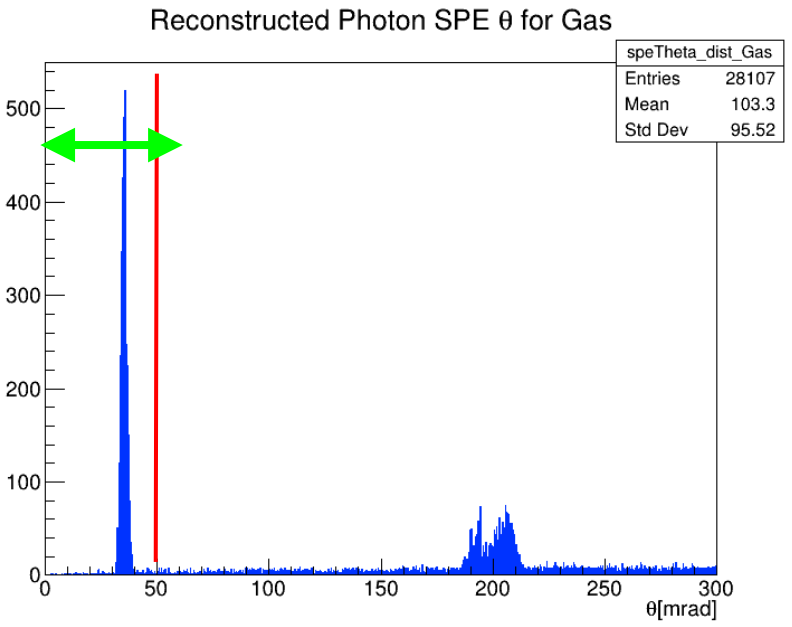


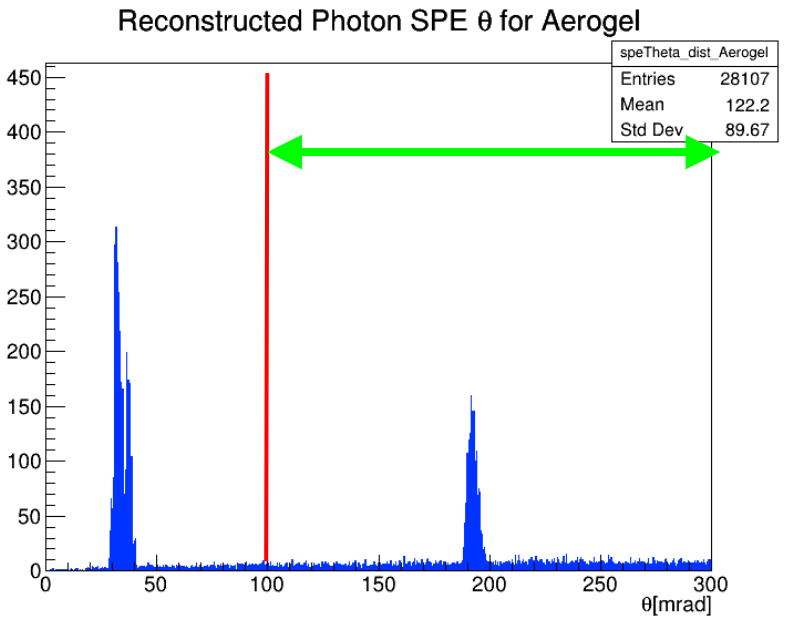
W/O Noise

1. Fit function is Gauss+pol1 for added noise. Pol1 parameters used to estimate noise under peak.
2. Central value and sigma from w/o noise (Gaussian distr.); 2*sigma window to compare integral. The Integral difference normalized to integral of noise added histo gives estimate of the noise contribution within the window.

Noise inside window = (3792-3364)/3792 ~ 11%
Noise Under peak = (-97.95+(0.51*192.3))/130.1 ~ 0.6%

Estimate of the ring angle





1. Peak is searched within limits.
2. A first approximate SPE sigma is passed. To make a brute peak within 3 sigma level.
3. These central value is reused to have a finer search within 5 sigma window for a peak for ring angle.

Ring angle and sigma