CKOV Digitization

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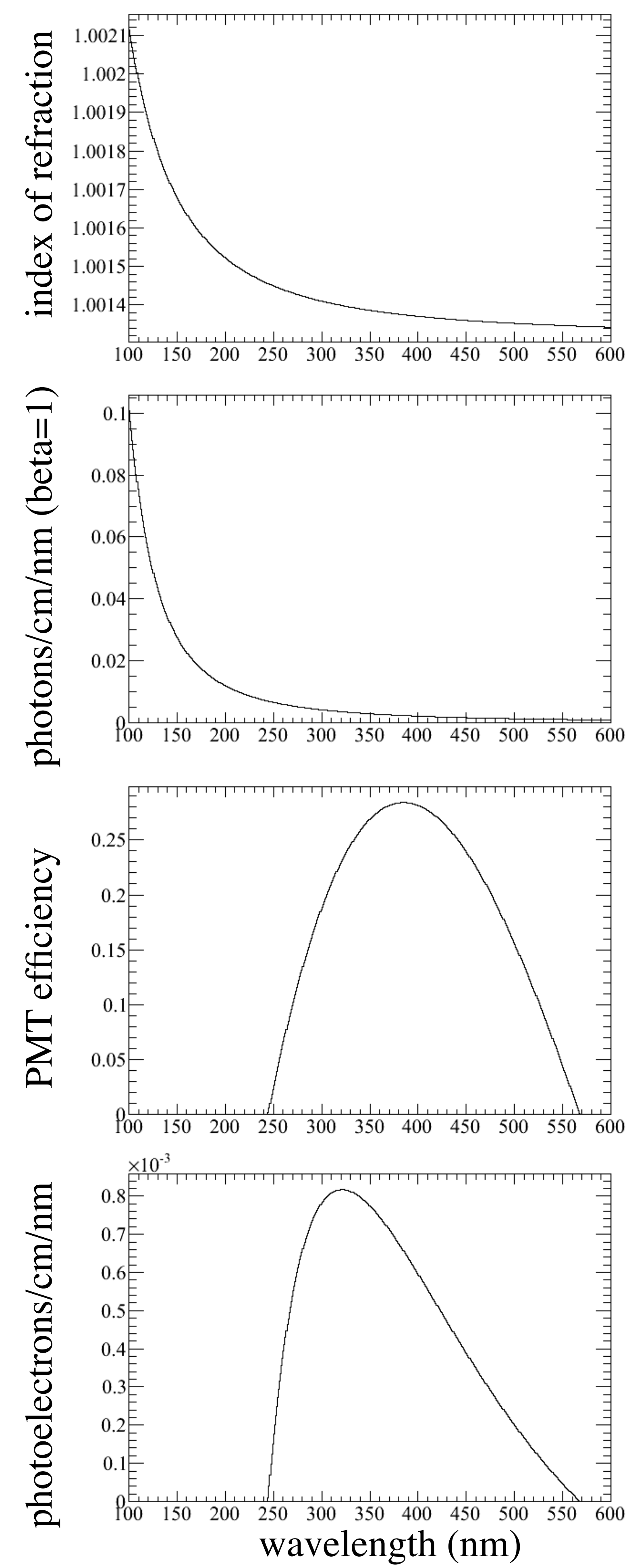
* I've been working to tune-up the CKOV digitization by comparing empty target data to simulations of straight-through 120 GeV protons.
* Simulation combines first principles with results from CKOV calibration.
* Basic method in place and tuned reasonably to data. Code:
  - CkovDigitizer/CkovDigi.[cxx,h], CkovDigitizer/CkovHitsToDigits.[cxx,h]
* Left to do: Simulation of thin-target data and compare all mirrors at the DST level, in particular, compare distributions which require a track associated with a mirror.

Calculation of N photoelectrons

1. For each GEANT hit in the CKOV, determine the number of Cherenkov photons produced as function of wavelength using data on the C4F10 index of refraction from D. Lange and which mirror they hit
2. Integrate against the PMT efficiency (data also from D. Lange)
3. Multiply this result by the photon yield determined by the calibration (cal1 from ckovcalibration database table) to account for mirror-to-mirror variations in efficiencies
4. Multiply by a tuning constant to match MC and data. Required in principle as the above procedure effectively double counts the PMT efficiency.
5. Enter result into a histogram of charge vs. time for the PMT
6. Theoretical yield is 23 photo-electrons for a straight-through particle with beta=1. In data, we see more like 7 - 10 on average.
7. To account for mirror-to-mirror variations in light collection efficiencies, I multiple the calculation from the previous steps by the calibrated response (Npe/cm). This is "cal1" from ckovcalibration DB table.
8. The preceding calculation effectively double counts the PMT efficiency since the calibrated response includes an integrated PMT efficiency. So, I scale the number of photon electrons up to put this factor back. The scale factor is tuned to data.

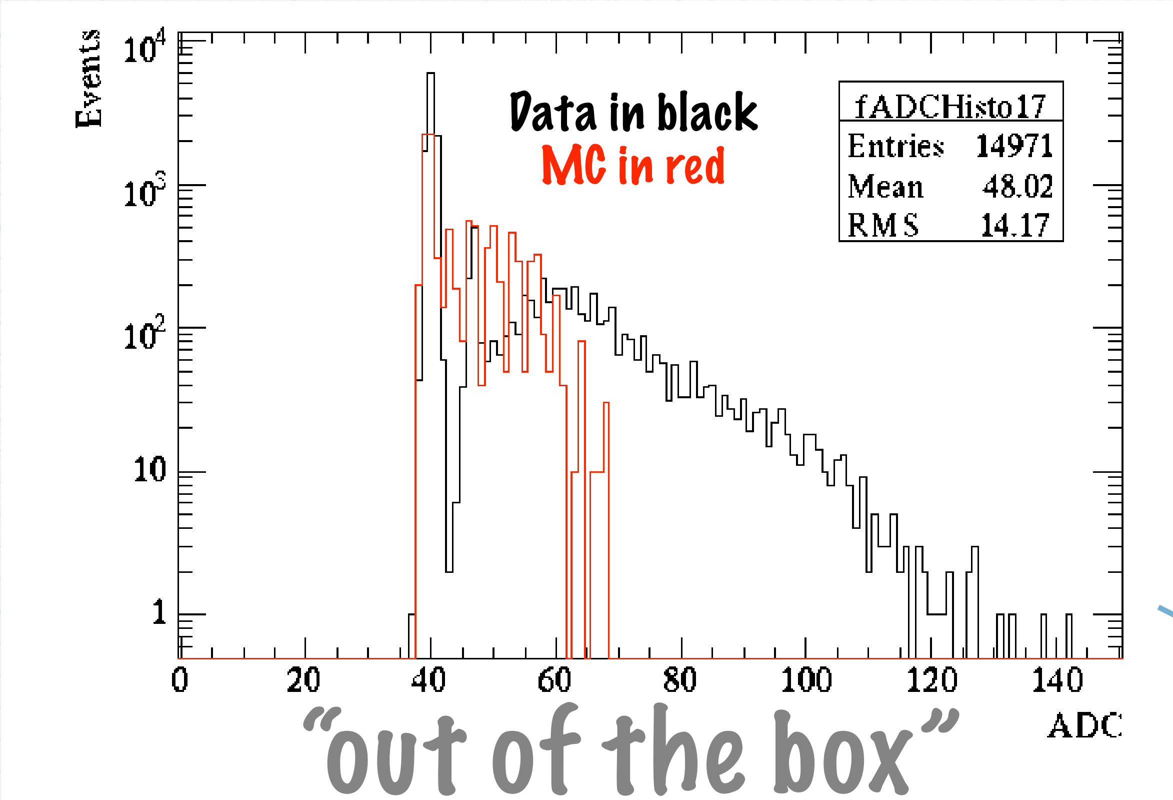


Calculation of ADC response

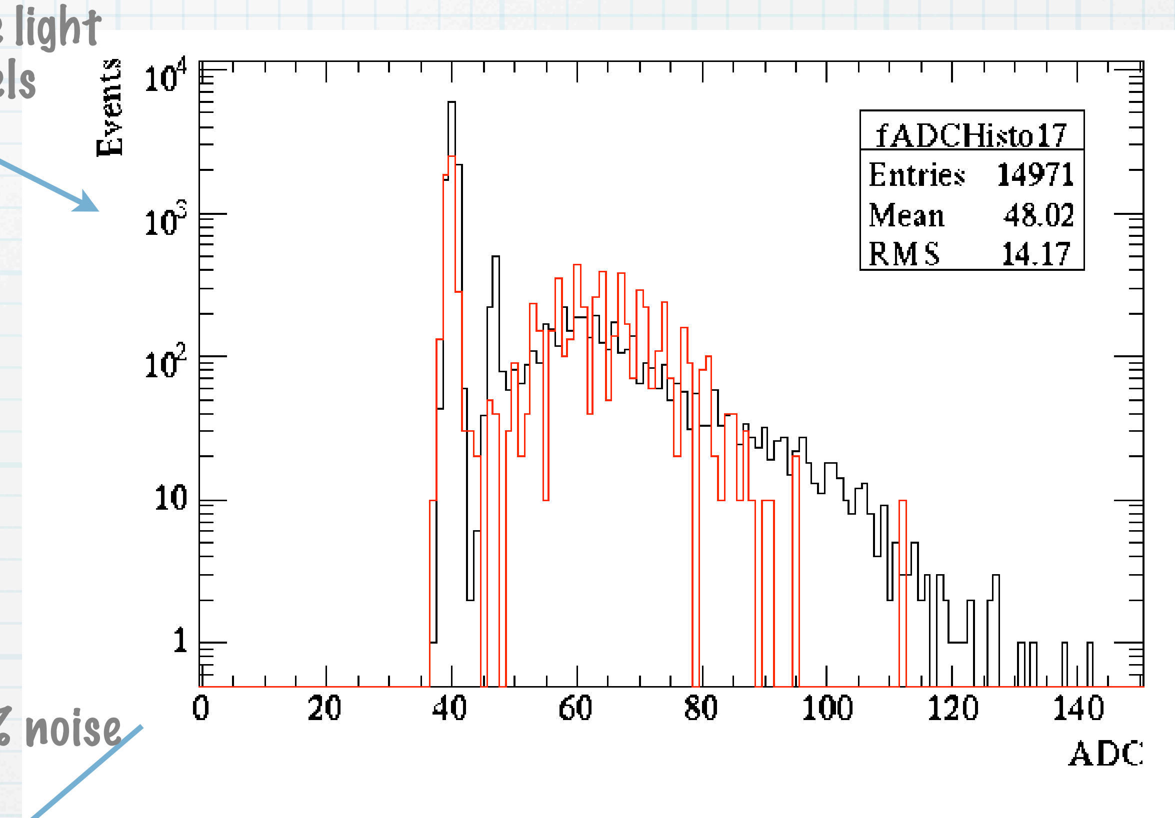
1. Integrate the charge-vs-time plot from -100 to +500 ns to get mean number of photo-electrons expected
2. Throw a Poisson random number against this mean
3. Convert to ADC using ADC to PE calibration ("cal0" from ckovcalibration DB table)
4. Add 5% Gaussian random noise (tuned to data)
5. Add pedestal and additional Gaussian noise from ckovpedestals DB table)
6. Since times are not used by reconstruction, I have not bothered with them

Tuning to data

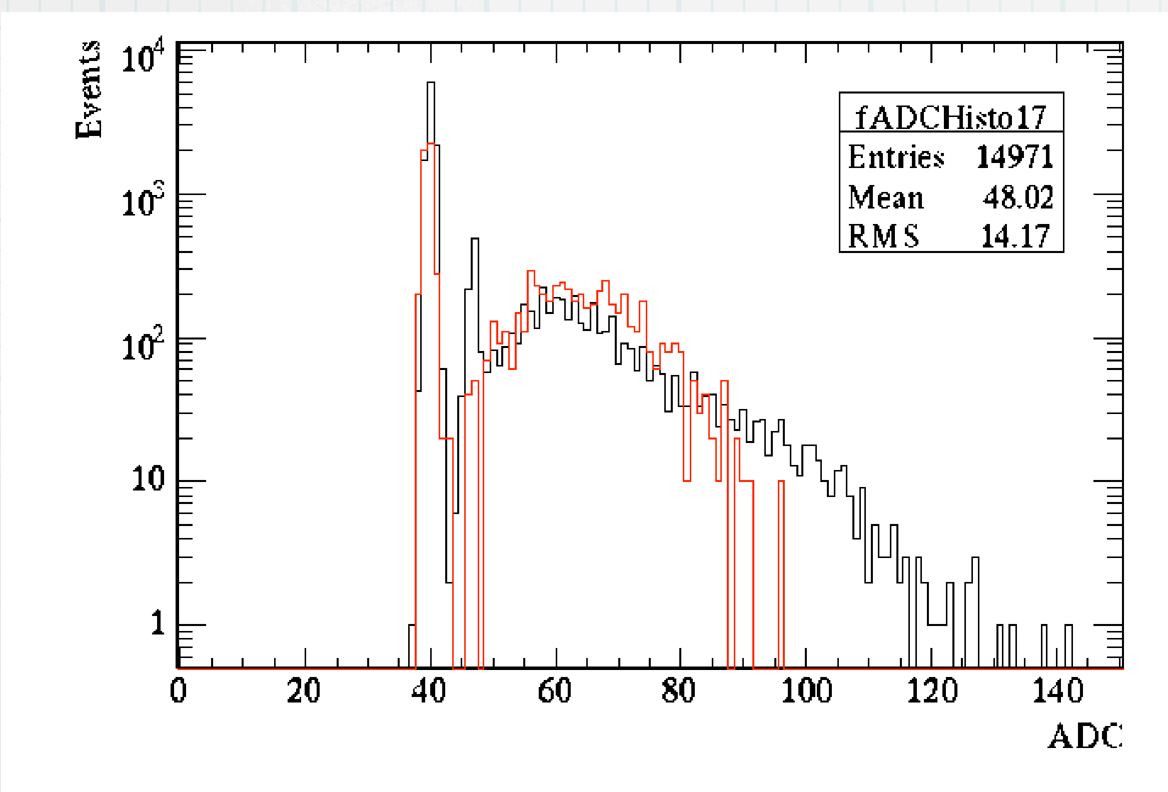
1. To tune I've compared 120 GeV straight-through protons with some empty 120 GeV running.
2. Caveat I: I'm showing all the data which will include interactions that are not there in the MC. I plan to run full reconstruction, but I have technical problems
3. Caveat II: The histograms below are normalized by eye



Scale by x2.5 to tune light levels



Add 5% noise



Some issues?

Lots of single PE's in the data. Why? Stray light from diffuse reflections? Not likely dark noise, 10 kHz of noise would contribute ~0.01 pe per event.

What's this component that peaks below pedestal??

Plan to look at this with full reconstruction. If these go away by requiring a track to hit the mirror, I'm not worried about them.