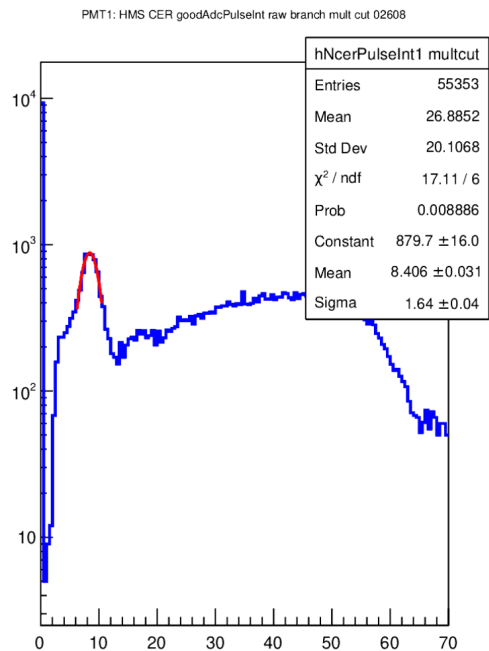# HMS Cherenkov Calibration

Method-1

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Procedure

- As a clear SPE peak spectrum is seen in the HMS CER, the good ADC pulse integral is fitted with Gaussian function. Then the mean is extracted from the fit and we put 1/mean in the calibration param.

- The cuts that were used on the ADC pulse integral (H.cer.goodAdcPulseInt) are the following:

1. Requiring goodAdcmultiplicity == 1 for the PMT under calibration.

2. Detector timing window cuts (H.cer.goodAdcTdcDiffTime) (already set in the corresponding parameter file in hallc_replay).
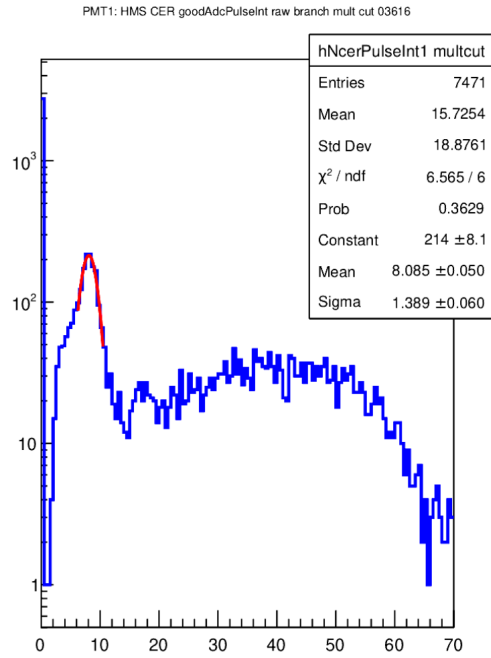
PMT 1

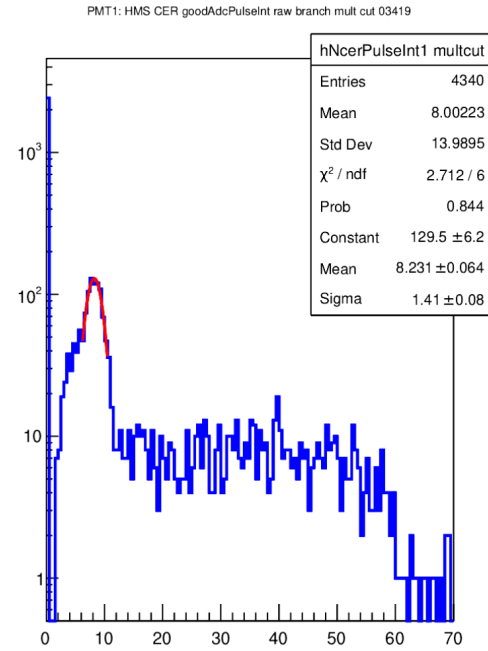- Gaussian fit to H.cer.goodAdcPulseInt (multiplicity==1) for different runs.

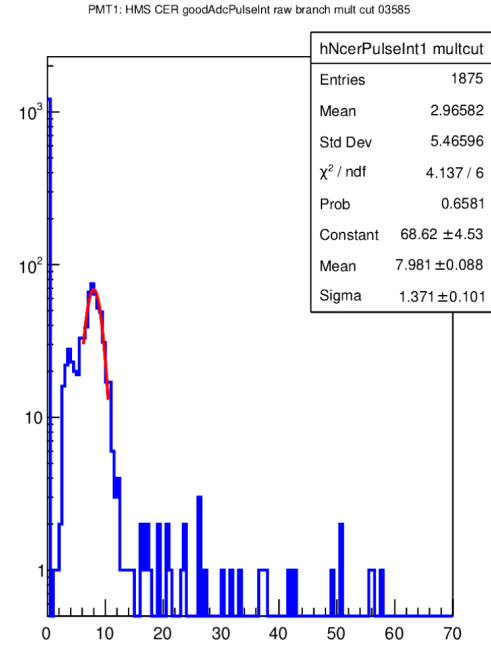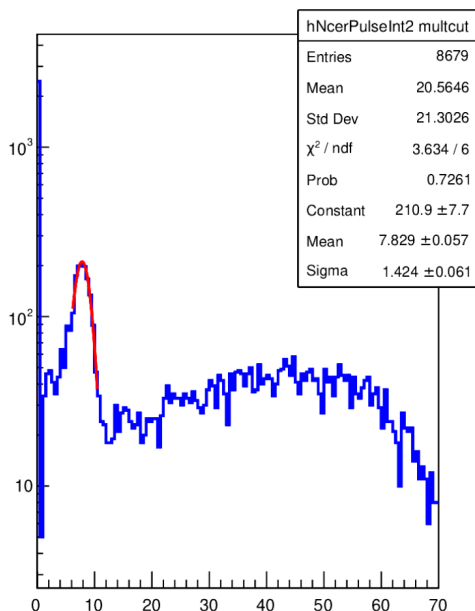| HMS Run 02608: 1-pass elastic, EL-CLEAN	HMS Run 03616: C-Optics/Sieve, EL-REAL	HMS Run 03419: DIS, 3/4	HMS Run 03585: Cosmics
1 / mean = 1 / 8.40605	1 / mean = 1 / 8.08504	1 / mean = 1 / 8.23131	1 / mean = 1 / 7.98096

PMT 2

- Gaussian fit to H.cer.goodAdcPulseInt (multiplicity==1) for different runs.

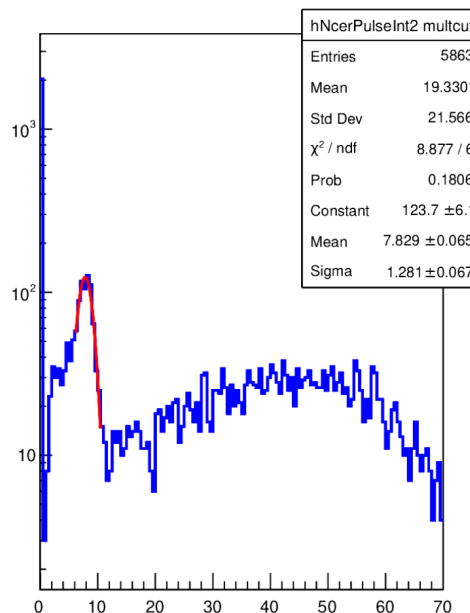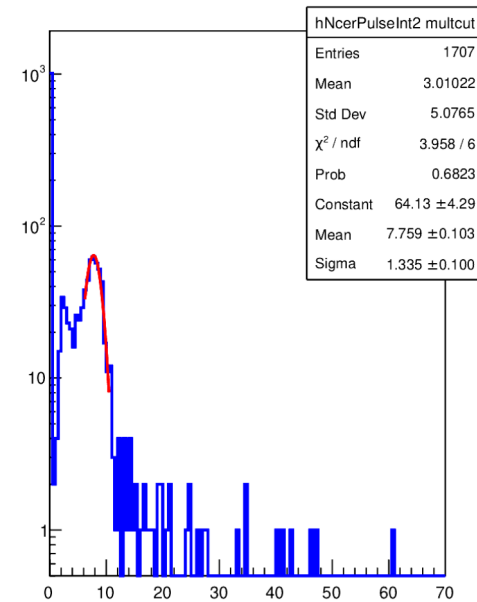|	
PMT2: HMS CER goodAdcPulseInt raw branch mult cut 02608	
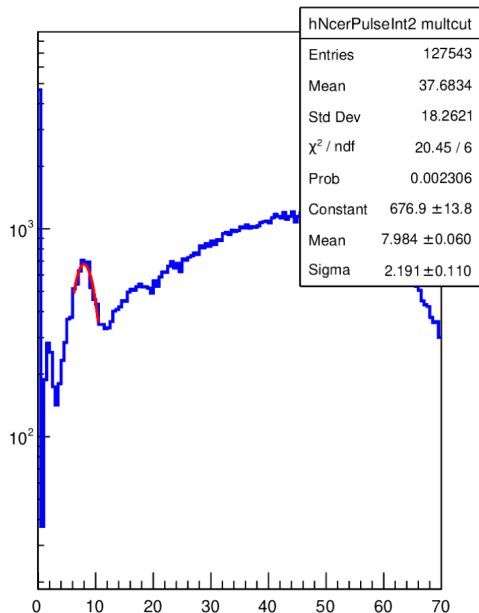
hNcerPulseInt2 multcut

Entries	127543
Mean	37.6834
Std Dev	18.2621
χ^2 / ndf	20.45 / 6
Prob	0.002306
Constant	676.9 ±13.8
Mean	7.984 ±0.060
Sigma	2.191 ±0.110

PMT2: HMS CER goodAdcPulseInt raw branch mult cut 03616

hNcerPulseInt2 multcut

Entries	8679
Mean	20.5646
Std Dev	21.3026
χ^2 / ndf	3.634 / 6
Prob	0.7261
Constant	210.9 ±7.7
Mean	7.829 ±0.057
Sigma	1.424 ±0.061

PMT2: HMS CER goodAdcPulseInt raw branch mult cut 03419

hNcerPulseInt2 multcut

Entries	5863
Mean	19.3301
Std Dev	21.566
χ^2 / ndf	8.877 / 6
Prob	0.1806
Constant	123.7 ±6.1
Mean	7.829 ±0.065
Sigma	1.281 ±0.067

PMT2: HMS CER goodAdcPulseInt raw branch mult cut 03585

hNcerPulseInt2 multcut

Entries	1707
Mean	3.01022
Std Dev	5.0765
χ^2 / ndf	3.958 / 6
Prob	0.6823
Constant	64.13 ±4.29
Mean	7.759 ±0.103
Sigma	1.335 ±0.100

HMS Run 02608: 1-pass elastic, EL-CLEAN

1 / mean =
1 / 7.98363

HMS Run 03616: C-Optics/Sieve, EL-REAL

1 / mean =
1 / 7.82941

HMS Run 03419: DIS, 3/4

1 / mean =
1 / 7.8286

HMS Run 03585: Cosmics

1 / mean =
1 / 7.75936

Calibration constants

The estimated calibration constants values per PMT are the following:

HMS Runs	PMT 1	PMT 2
Old Param file (Cosmics 2504)	1 / 8.409	1 / 7.735
2608 (Elastic) (Old replay)	1 / 8.40605	1 / 7.98363
3616 (C-Optics / Sieve) (Old replay)	1 / 8.08504	1 / 7.82941
3419 (DIS) (Old replay)	1 / 8.23131	1 / 7.8286
3585 (Cosmics) (Old replay)	1 / 7.98096	1 / 7.75936

Questions

1. The calibration constants in the old param file were estimated from Cosmic run 02504.
I have done the calibration with a new cosmic run 03585. There is a slight difference in the fit parameters for the two cosmics.

Can we expect that ?

2. Do we need to apply anymore cuts (eg. Mirror cuts etc.) like method 2 ?

3. The calibration constants are a bit different for different runs. How should we choose one ?

New replay: New param file with PMT 1= 1 / 8.08504 and PMT 2 = 1 / 7.82941 (obtained from run 2608 SPE fit)
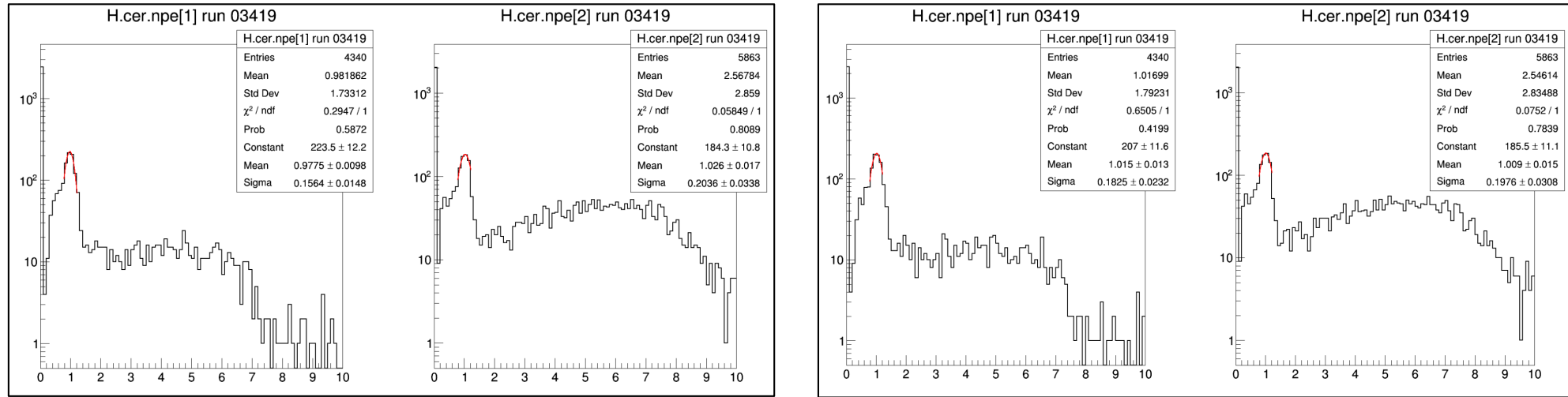
HMS run 3419 (DIS): Comparing H.cer.npe for old and new replay

H.cer.npe is fitted with Gaussian function. The mean of the fits are the following:

- **Old Replay:** PMT1 = 0.9775 ± 0.0098, PMT2 = 1.026 ± 0.017

- **New Replay:** PMT1 = 1.015 ± 0.013, PMT2 = 1.009 ± 0.015

NPE has changed a little!