

HCAL Reconstruction: MC Correction Functions Update

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BROWN

Introduction

- Have derived MC correction functions for OOT PU
- Same derivation method as used for data
- Procedure:
 - Run Alexandre's ratio method on zero PU MC
 - Derive correction functions based on the pulse shape
 - Use the same definitions, fits, and methods as in data
 - **Validate results on MC with OOT PU**

Method

- Process a high- p_T QCD sample in two ways:
 - No pileup: for MC truth comparison (DONE)
 - With pileup: for validation (Processing)
- Compare results event-by-event, channel-by-channel:
 - No pileup
 - vs. with pileup and no corrections
 - vs. with pileup and corrections

Datasets

- Consider two GEN-SIM datasets (no PU) at T1_US_FNAL:

Dataset	Production release
/MinBias_TuneZ2star_13TeV-pythia6/Summer13-START53_V7C-v1/GEN-SIM	CMSSW_5_3_10_patch2
/QCD_Pt-1800_TuneZ2star_13TeV_pythia6/Fall13-POSTLS162_V1-v1/GEN-SIM	CMSSW_6_2_0_patch1

- QCD_Pt-1800 dataset:

- [DAS link](#)

- 93453 ($\sim 100k$) events, 95 files

- HcalNoiseAnalyzer ntuples on FNAL EOS:

/eos/uscms/store/user/eberry/QCD1800MC/

- MinBias dataset:

- [DAS link](#)

- 9999424 ($\sim 10M$) events, 946 files

- HcalNoiseAnalyzer ntuples on FNAL EOS:

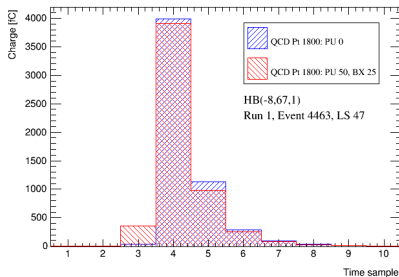
/eos/uscms/store/user/eberry/MinBiasMC/

Processing pileup sample

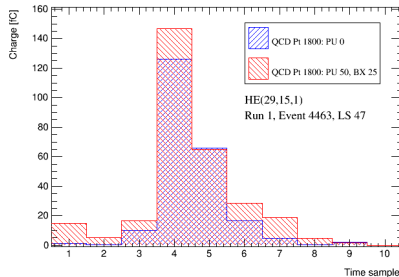
- Need to overlay QCD with MinBias
- Use `MixingModule` in `CMSSW_6_2_8`
- Pileup scenario: `AVE_50_BX_25ns`
- Two stages:
 - 1) DIGI, L1, DIGI2RAW, HLT
 - 2) RAW2DIGI L1Reco RECO
- Stage 1 all done: `cmsDriver` and `python cfg`
- Stage 2 part done: `cmsDriver` and `python cfg`
- High PU is **VERY** CPU intensive: 2 minutes/event

Pileup vs. No Pileup pulse shape comparison

single DIGI comparison: HB



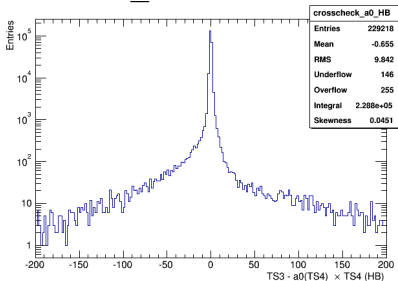
single DIGI comparison: HE



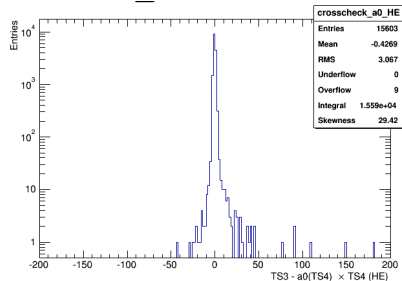
- HE as expected.
- HB as expected in TS3. Strangeness in TS4 + TS5.
- Bug in MixingModule? Investigating with M. Hildreth.

Function validation on zero pileup sample: a_1

a_1 in HB

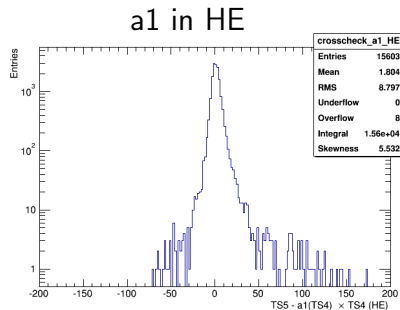
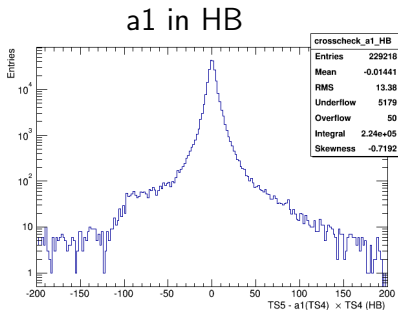


a_1 in HE



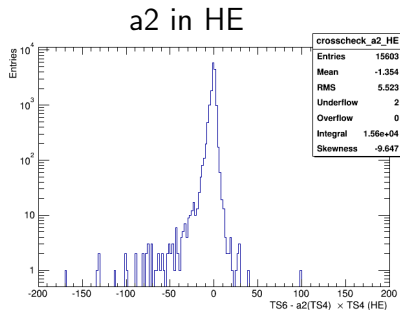
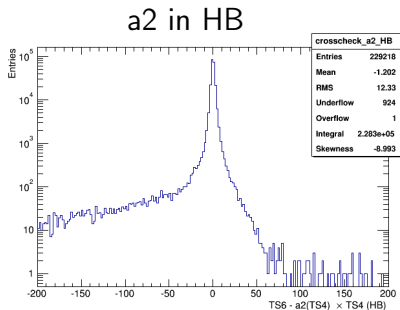
- Sample has zero pileup
- Sample size is much smaller in HE (more events coming)

Function validation on zero pileup sample: a1



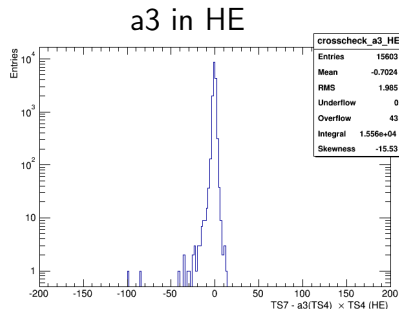
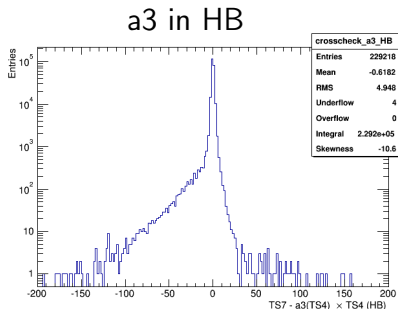
- Sample has zero pileup
- Tails need investigation
- Sample size is much smaller in HE (more events coming)

Function validation on zero pileup sample: a2



- Sample has zero pileup
- Tails need investigation
- Sample size is much smaller in HE (more events coming)

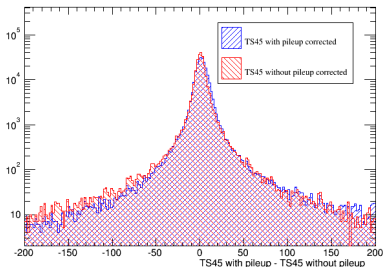
Function validation on zero pileup sample: a3



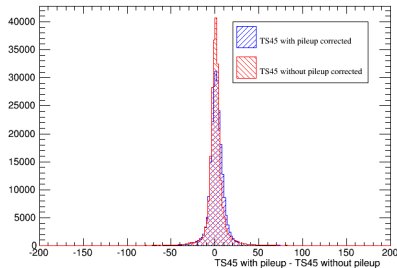
- Sample has zero pileup
- Tails need investigation
- Sample size is much smaller in HE (more events coming)

Effect of corrections

Log scale



Linear scale



- Corrected mean (blue) = 2.21 fC, RMS = 16.1 fC
- Uncorrected mean (red) = 0.76 fC, RMS = 16.6 fC

Conclusion

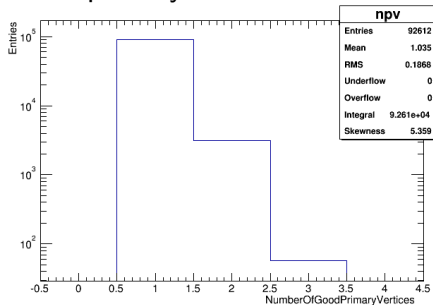
- Processed zero-pileup samples: OK for shape studies
- Processed high-pileup samples: OK for validation
 - Processing takes **MUCH** longer than expected
 - Strange features. Small effect in the end.
 - Investigating further.
- Preliminary results ready using Alexandre's method
 - Fit functions used for data model MC pulse shape well
 - Request from Salavat to increase the fit range: coming
- Working on validating results to put into CMSSW
- Suggestion from Artur: look at MC that approximates Alexandre's data

Selection

- Event selection:
 - No trigger requirement
 - No OfficialDecision requirement
 - `NumberOfGoodPrimaryVertices` > 0
- Channel selection:
 - Only HBHE considered
 - Rings: HB, HE: {17:20, 21:23, 24:25, 26:27, 28:28}
 - No channels in bad channels list
 - RecHit energy > 1 GeV
 - Charge > 5 fC
- Analyzer code:
 - [Git page](#)

N(vertex)

Number of primary vertices: QCD sample



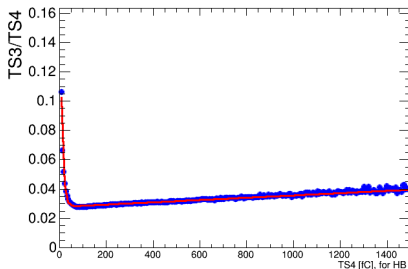
- 92612 events passing event selection
- Confirms no pileup, as expected

Definitions

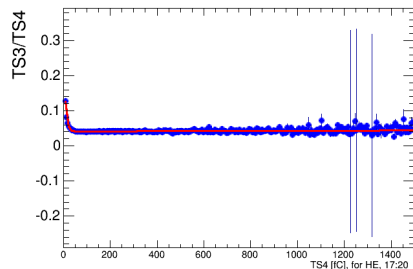
- The following plots show TProfile distributions
- One entry per HCAL digi in the ZS-collection
- x-axis corresponds to charge in TS4 [fC]
- y-axis corresponds to one of several charge ratios:
 - a_1 : charge in TS3 [fC] / charge in TS4 [fC]
 - a_1 : charge in TS5 [fC] / charge in TS4 [fC]
 - a_2 : charge in TS6 [fC] / charge in TS4 [fC]
 - a_3 : charge in TS7 [fC] / charge in TS4 [fC]

a_1(TS4) in the QCD sample

a_1(TS4) in HB



a_1(TS4) in HE 17:20

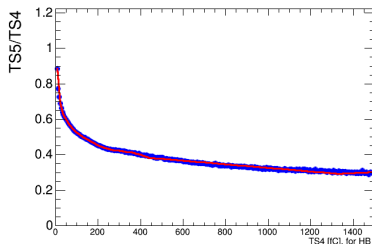


- Fit with exponential + polynomial:

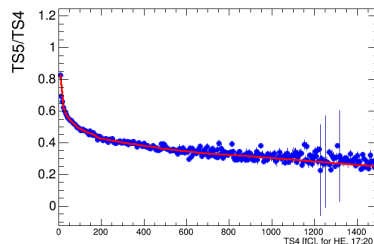
$$a_1(TS4) = [0] + [1] \cdot TS4 + \text{Exp}([2] + [3] \cdot TS4)$$

a1(TS4) in the QCD sample

a1(TS4) in HB



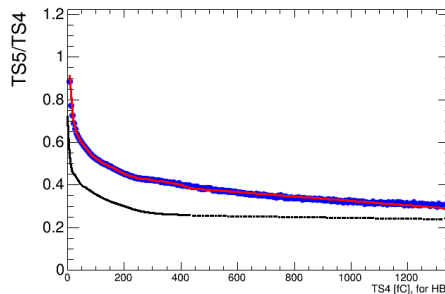
a1(TS4) in HE 17:20



- Fit with multiple polynomials (same shape as in data)
- Fit function describes the shape well
- Numeric results and data comparison next slide

a1(TS4) Data vs QCD MC

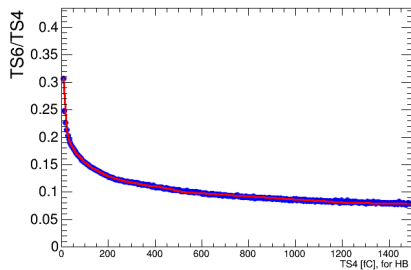
a1(TS4) Data vs Monte Carlo in HB



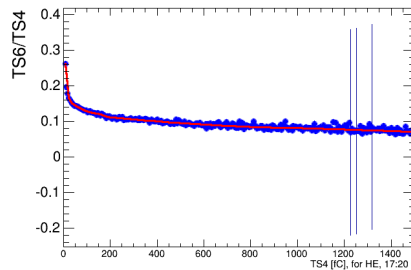
- Blue points: MC
- Red line: MC fit
- Black line: data fit (from Alexandre)

a2(TS4) in the QCD sample

a2(TS4) in HB

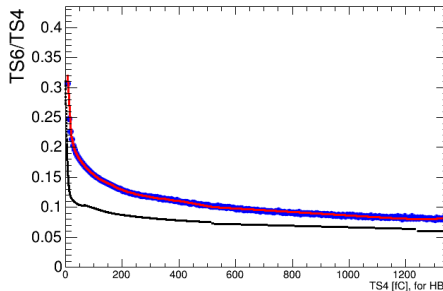


a2(TS4) in HE 17:20



a2(TS4) Data vs QCD MC

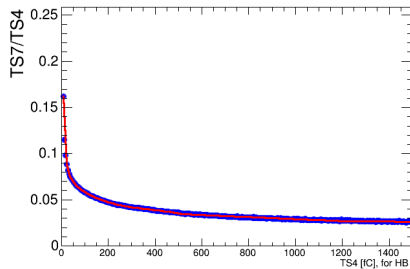
a2(TS4) Data vs Monte Carlo in HB



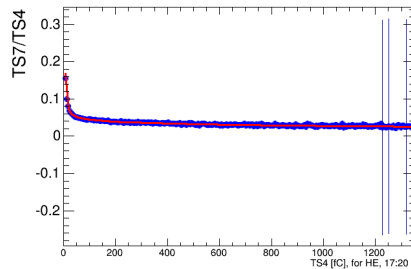
- Blue points: MC
- Red line: MC fit
- Black line: data fit (from Alexandre)

a3(TS4) in the QCD sample

a3(TS4) in HB

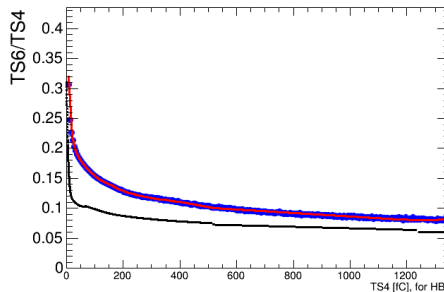


a3(TS4) in HE 17:20



a3(TS4) Data vs QCD MC

a3(TS4) Data vs Monte Carlo in HB



- Blue points: MC
- Red line: MC fit
- Black line: data fit (from Alexandre)