Overview
- Studied and characterized common noise types
- Implementing new variable into the HCal baseline filter; also used in MET HLT paths – help preventing prescale for physics
- Developed and implemented a set of pulse-shape discriminants to identify noise with HCal-only information
- Implemented noise monitoring histograms into offline DQM

Characterization of HBHE Anomalous Noise
- Anomalous signal has been observed in HBHE which can go up to very high energy
- Insensitive to beam intensity
- Traditionally it is classified into Ion Feedback (low hit multiplicity), HPD noise and RBX noise
  - A large class of low-multiplicity noise is characterized by large energy deposit in single time slice (25ns), and silent afterwards
    - Usually neighbors in HPD pixels
  - Another large class is the pedestal-drifting noise, which is seen as collective behavior of HPD/RBX
- We can also look at HPD pixels to identify problematic patterns

Standard HCal Noise Baseline Filter – Event Rejection
- Starting 2011, with the 50ns colliding bunch spacing, the old filter which used E2/E10 does not work anymore due to the presence of out-of-time pileup
- A new variable (R45) is investigated to serve as a replacement
  - R45 = (TS4-TS5)/(TS4+TS5), where TS4 is the trigger (in-time) energy deposit, and TS5 is the next time slice (25ns)
- 50% of noise is rejected with this baseline filter
- A similar version is implemented in HLT in MET paths
- Saved physics triggers, for example MET120
- Extra safety measure compared to offline filter: if more than 2 RBX above minimum energy, keep event.
- Large rate reduction is observed on MET paths
  - Greatly increases physics trigger purity
  - Allows MET path with lower thresholds to survive longer without prescaling

Fit-based Filter – RecHit Cleaning
- By comparing compatibility to signal and noise hypotheses, we can pick out noise-like pulses
- Provides good handle orthogonal to any other noise filters
- Three discriminants designed and results stored in rechit
  - Linear discriminant
    - Designed to target the pedestal-drifting type of noise
    - Compare χ² from fit to nominal pulse shape and χ² from fit to linear hypothesis
    - Discriminant = log(Nominal χ²) – log(Linear χ²)
  - Spike-like discriminant
    - Targets low hit-multiplicity, “spike-like” noise
    - Compare nominal χ² to RMS value of the 8 TSs with smaller energy divided by maximum TS
    - Discriminant = log(Nominal χ²) – 2 log(RMS/Max)
  - Triangle discriminant
    - Fit the pulse with a triangle and examine if the rising/falling edge is compatible with signal
    - Performance on 2011 data show that it’s very safe and capable of picking out noise
  - Provides another way to map out noise in data, complementing traditional noise monitoring tools
- Insensitive to pileup conditions

HCal Noise DQM
- Implemented noise monitoring plots into HCal offline DQM
- Includes basic distributions such as maximum hit in HPD, ADC zero count, etc.
- Also includes fit-based filter plots and isolation-based filter plots, as well as eta-phi map of noise
- Trend monitoring

Roughly 70% of energy deposit in TS4, 20% in TS5, and some small tail afterwards
- Good pulse
- Spike-like
- Pedestal drifting

Energy

Reduces MET tail after applying the baseline filter while leaving the core distribution unmodified

Example of triangle fit to extract rising/falling edge

Clear structure of HPD in the “pedestal-drift”-like noise

Safe while being able to clean noise

HPD Noise

Example noisy pulse

Difference of MET before and after cleaning

All Good Events

Bad Events