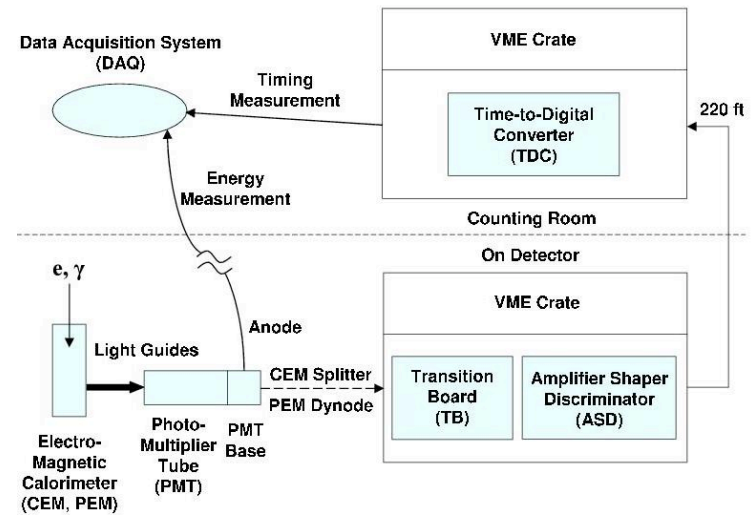
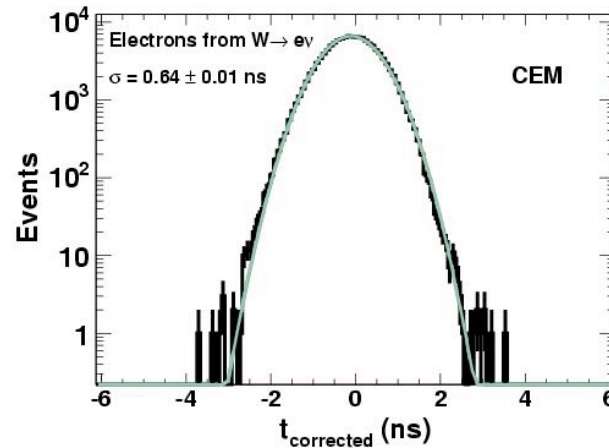
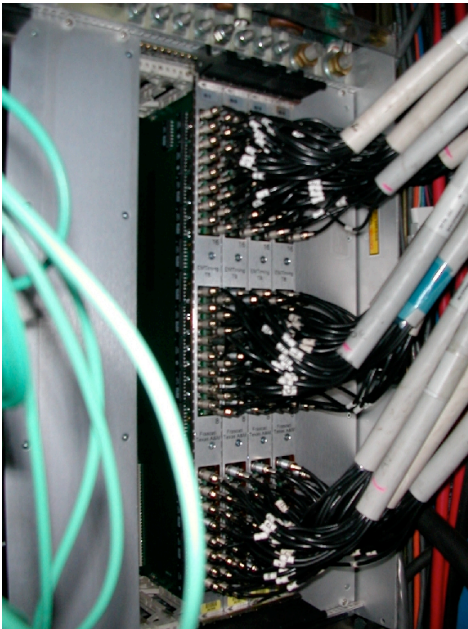




# EMTiming Validation



Eunsin Lee and Adam Aurisano for the EMTiming Group  
Texas A&M University  
Photon Meeting



# Outline

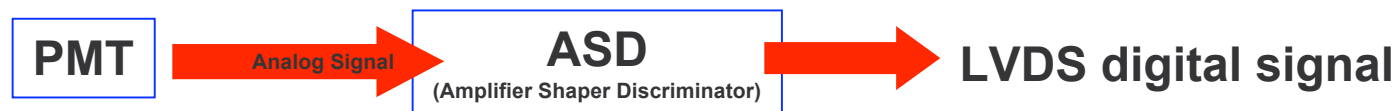


- Calibration Strategy
- Validating the Hardware
- Online results using ObjectMon
- Validation of the calibration
- Timing Mean and RMS vs. Store number
- Conclusions



# Calibration Strategy for EMTiming

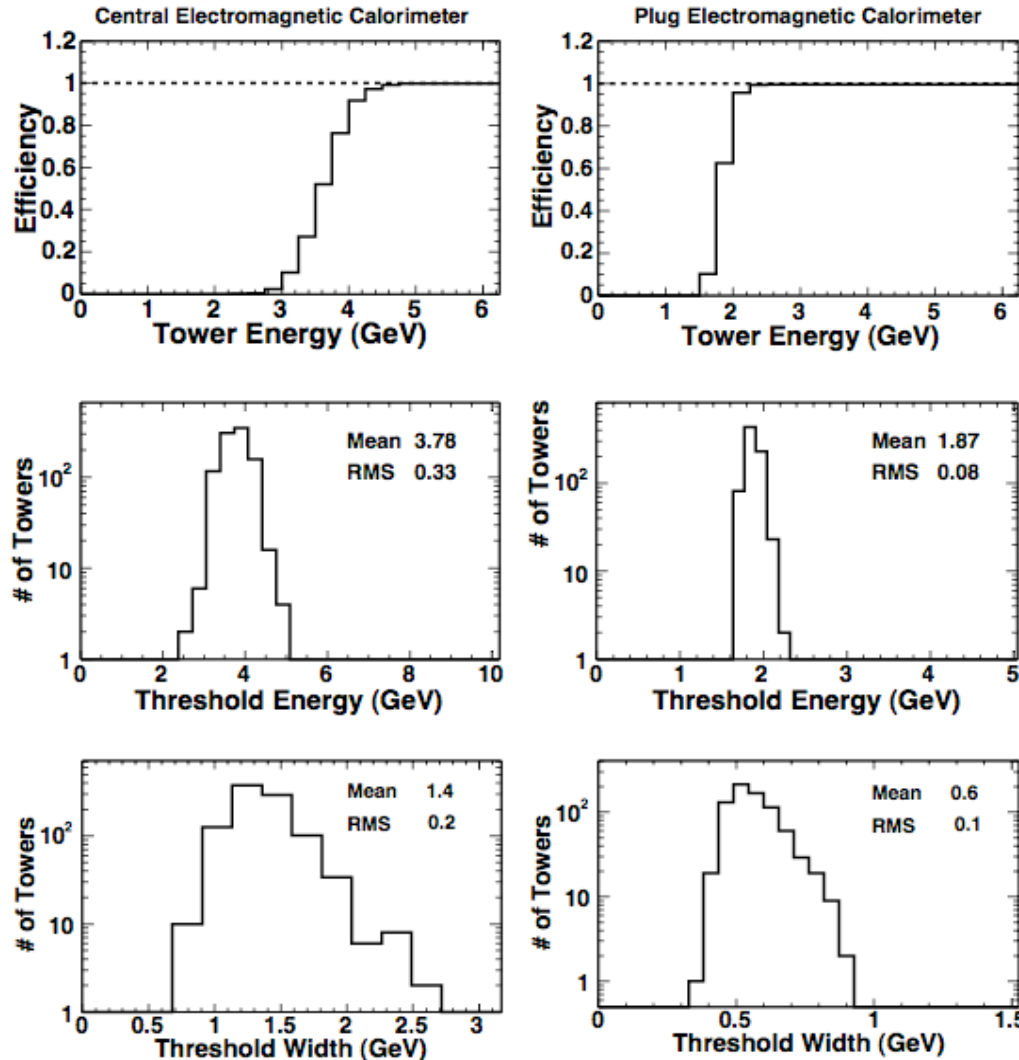
1. Produce calibration tables to get rid of the channel-by-channel hardware effects
2. Timing information depends on energy (slewing corrections), especially in high energy region:



3. Correct the timing information (for each channel) as a function of energy and put the fit parameters into the Calibration table



# The EMTiming system response as a function of the energy deposited in the EM calorimeter



12/19/07

Nucl.Instrum.Meth. A563, 543 (2006)

- The efficiency = the ratio of number of events with time recorded in TDC to all events
- Include all tower together
- The distribution is well described by an error/smeared step function

$$Erf(E_{th}, \sigma \epsilon)$$

where  $E_{th}$  is the threshold,  
 $\sigma$  is the transition width at threshold,  
 $\epsilon$  is the plateau efficiency

- The threshold and width

CEM :  $3.8 \pm 0.3$  GeV,  $1.4 \pm 0.2$  GeV  
 PEM :  $1.9 \pm 0.1$  GeV,  $0.6 \pm 0.1$  GeV

Measured performance after  
 commissioning



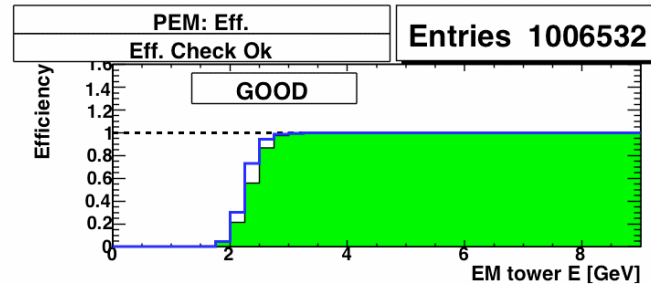
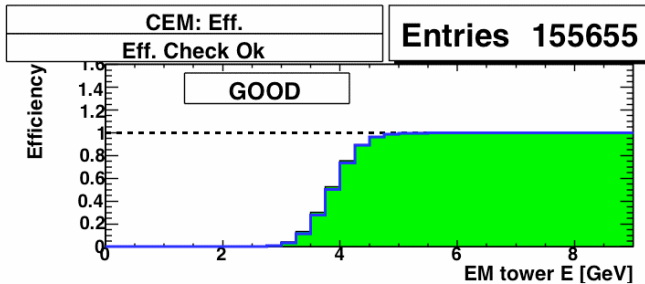
# Check Hardware and Calibrations

( Online ObjectMon plots )

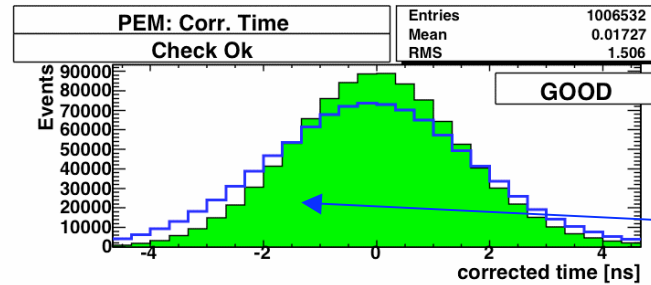
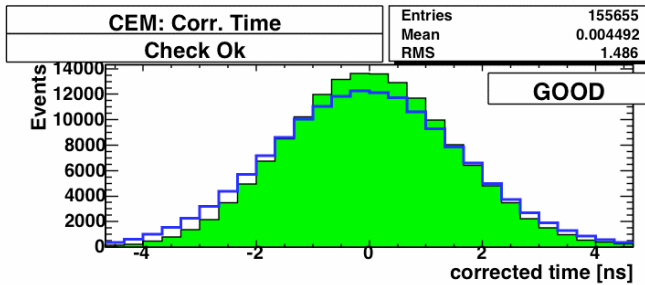


## ObjectMon #4 TimeMonitor EMTDC Timing

Run:254662 Event: 2920811 # of Events:150000 Time: Wed Dec 19 02:55:55 2007 Ref.Run:243070

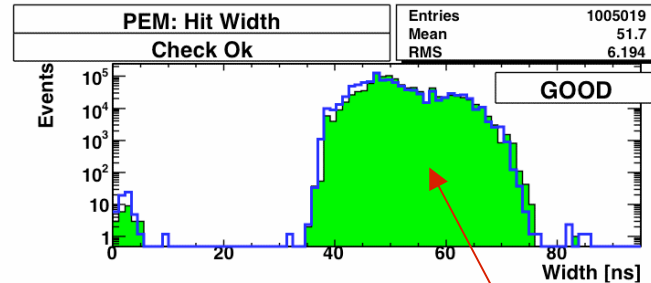
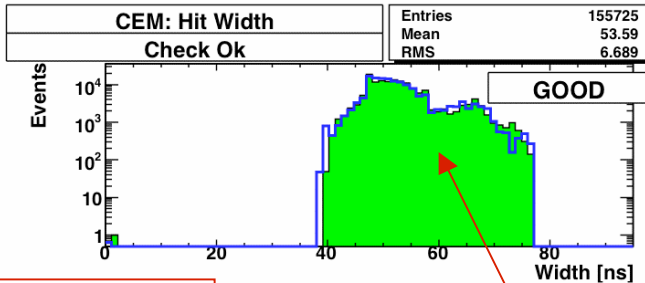


Hardware is working well



Calibration of the whole system is done well

Blue line is reference



Hit Width for Experts  
: The length of time of the digital pulse from ASD

The transfer of the pulse from detector to TDC happens properly



# Timing After Calibration Online

( ObjectMon plots )

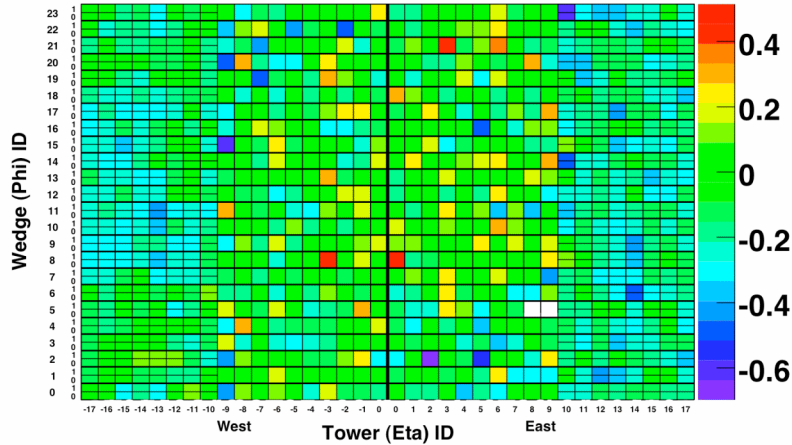


ObjectMon #12 TimeMonitor EMTD: Mean Corrected  $t_0$  - High Energy

Run:254662 Event: 2920811 # of Events:150000 Time: Wed Dec 19 02:55:55 2007 Ref.Run:243070

EMTDC: Mean Corrected  $t_0$  - High Energy  
purple or red - problems

ASD Time Window is  
520 ns <  $t_1$  < 660 ns  
CEM(Even+Odd) > 9000 ADC  
PEM(Even+Odd) > 2000 ADC  
 $t_{\text{sync}} < 15.0$  ns

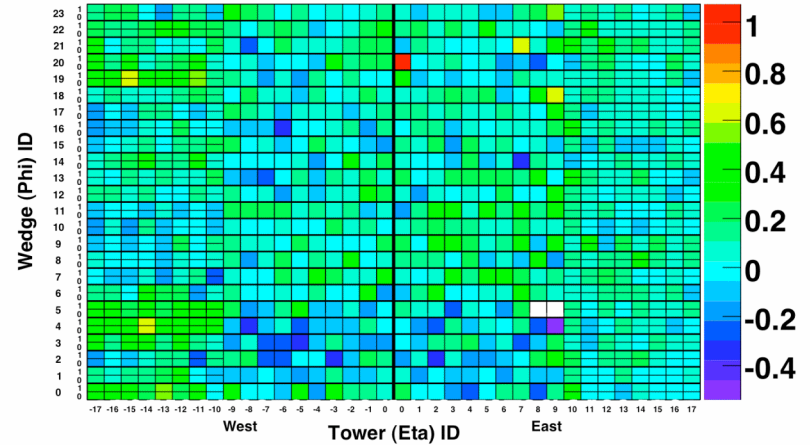


ObjectMon #13 TimeMonitor EMTD: Mean Corrected  $t_0$  - Low Energy

Run:254662 Event: 2920811 # of Events:150000 Time: Wed Dec 19 02:55:55 2007 Ref.Run:243070

EMTDC: Mean Corrected  $t_0$  - Low Energy  
purple or red - problems

ASD Time Window is  
520 ns <  $t_1$  < 660 ns  
CEM(Even+Odd) < 9000 ADC  
PEM(Even+Odd) < 2000 ADC  
 $t_{\text{sync}} < 15.0$  ns

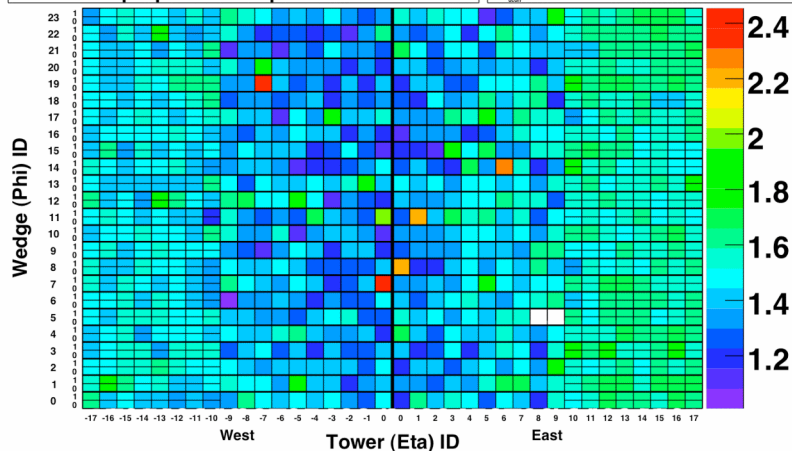


ObjectMon #14 TimeMonitor EMTD: RMS for Corrected  $t_0$  - High Energy

Run:254662 Event: 2920811 # of Events:150000 Time: Wed Dec 19 02:55:55 2007 Ref.Run:243070

EMTDC: Corrected  $t_0$  RMS - High Energy  
purple or red - problems

ASD Time Window is  
520 ns <  $t_1$  < 660 ns  
CEM(Even+Odd) > 9000 ADC  
PEM(Even+Odd) > 2000 ADC  
 $t_{\text{sync}} < 15.0$  ns

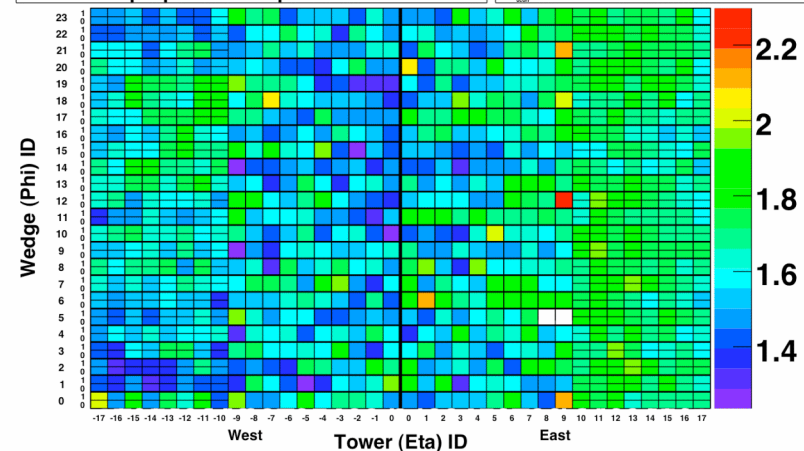


ObjectMon #15 TimeMonitor EMTD: RMS for Corrected  $t_0$  - Low Energy

Run:254662 Event: 2920811 # of Events:150000 Time: Wed Dec 19 02:55:55 2007 Ref.Run:243070

EMTDC: Corrected  $t_0$  RMS - Low Energy  
purple or red - problems

ASD Time Window is  
520 ns <  $t_1$  < 660 ns  
CEM(Even+Odd) < 9000 ADC  
PEM(Even+Odd) < 2000 ADC  
 $t_{\text{sync}} < 15.0$  ns





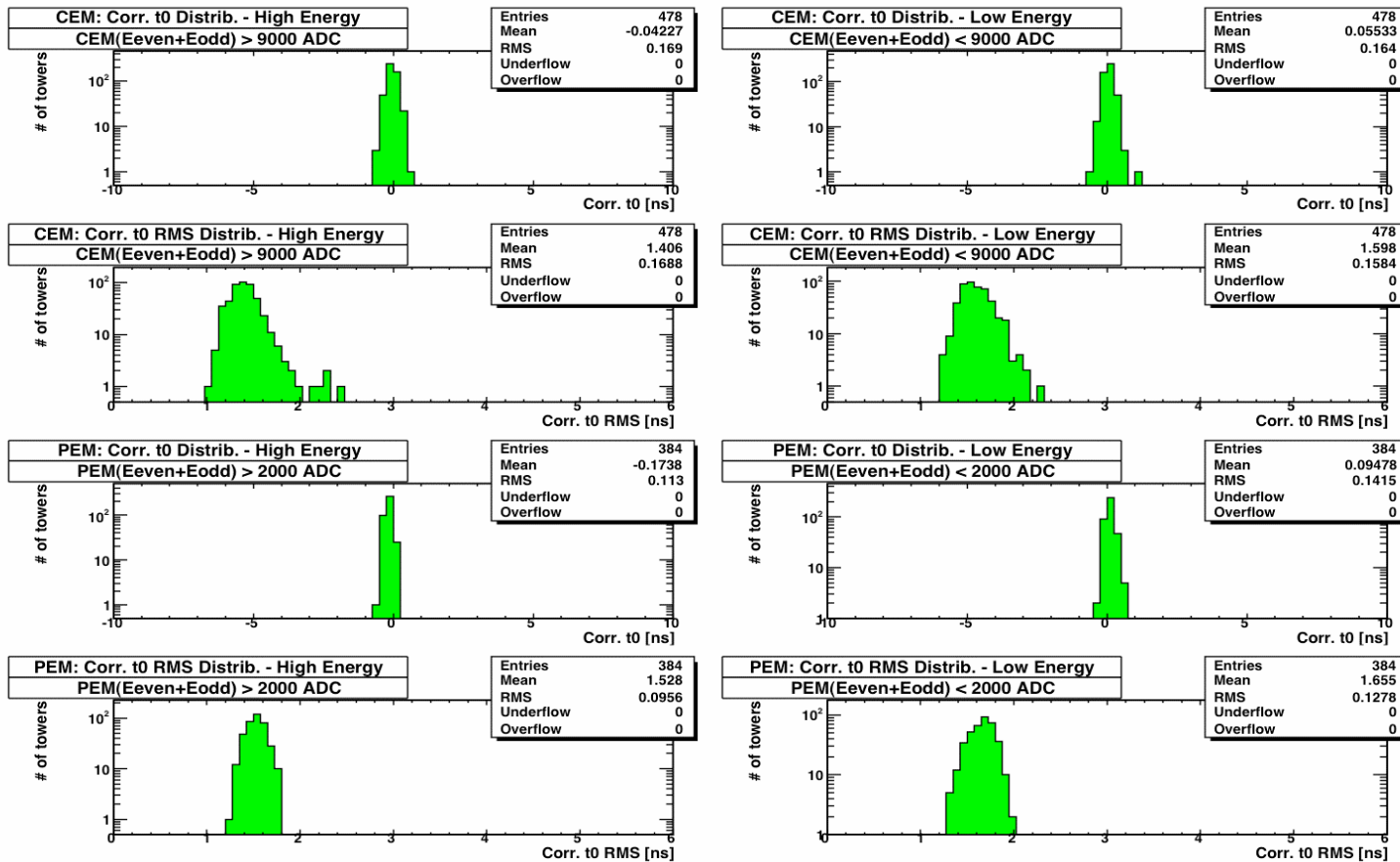


# Timing after Calibration (Uniformity)

## (Online ObjectMon Plot)



**ObjectMon #16 TimeMonitor EMTD: Corrected t0 and RMS**  
Run:254662 Event: 2920811 # of Events:150000 Time: Wed Dec 19 02:55:55 2007 Ref.Run:243070

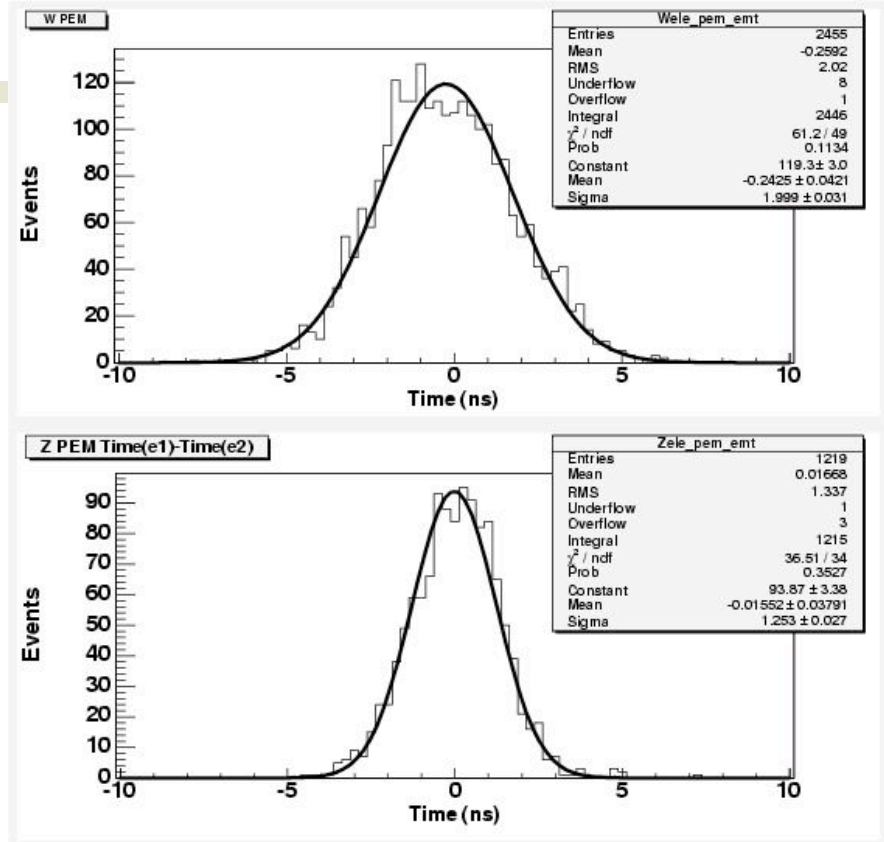
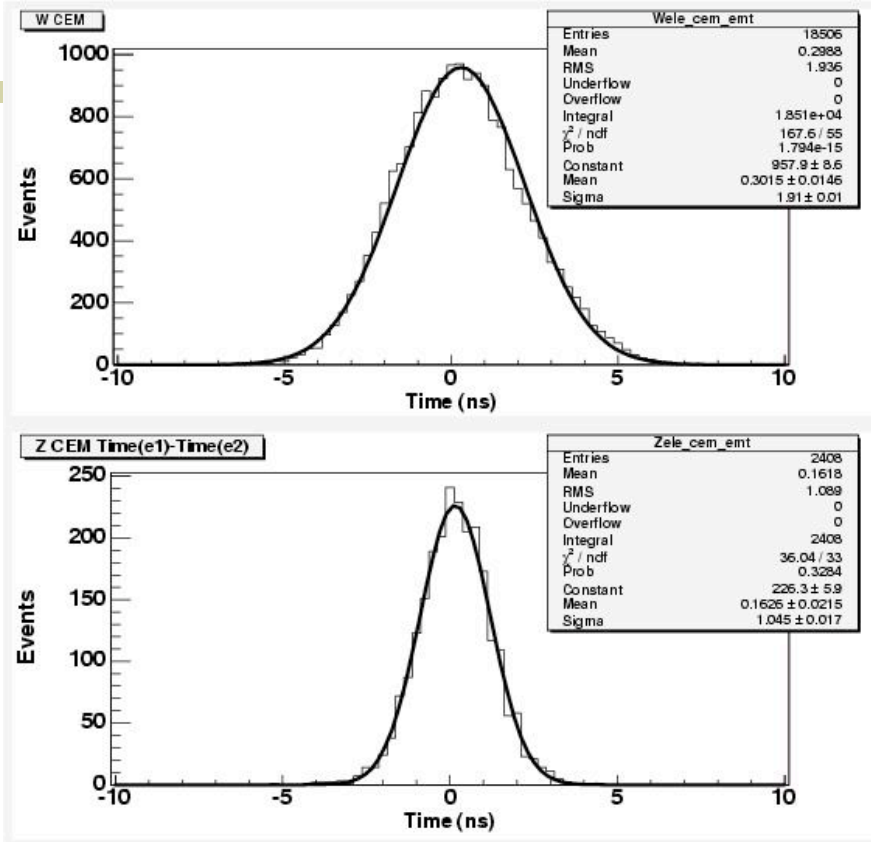


The system responding uniformly



# Offline Checks with W's and Z's

Run Range: 207079 - 210008



All distributions look normal, no gross mis-calibration is detected. There is a shift in the mean of the timing distribution for CEM, but it will be taken out by the Run-by-Run corrections.

$W \rightarrow e\nu$  : The arrival time of electron

MEAN  $\sim$  0 ns

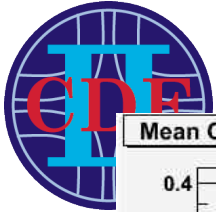
RMS  $\sim$  1.6 ns

$Z \rightarrow ee$  : The arrival time difference of two electrons

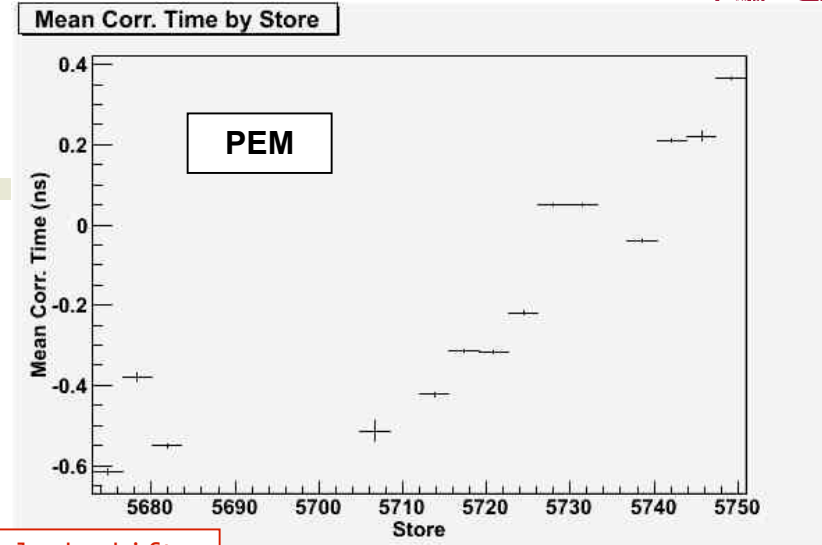
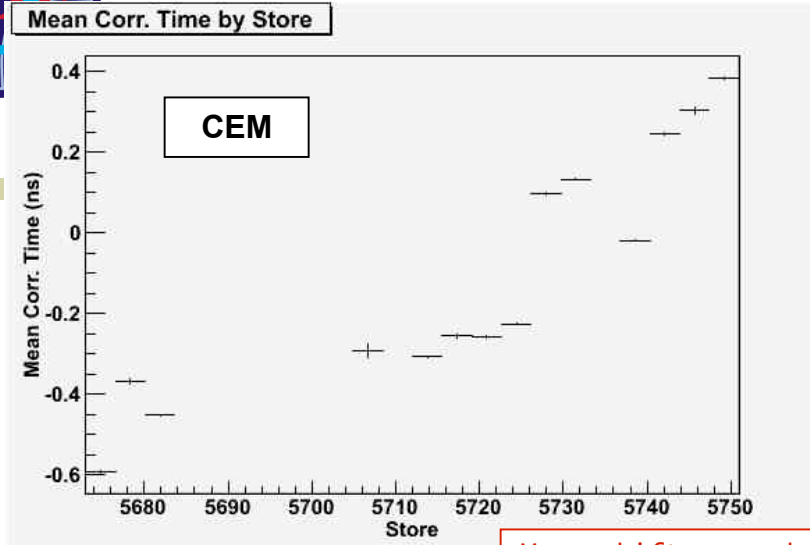
MEAN  $\sim$  0 ns

RMS  $\sim$  1 ns

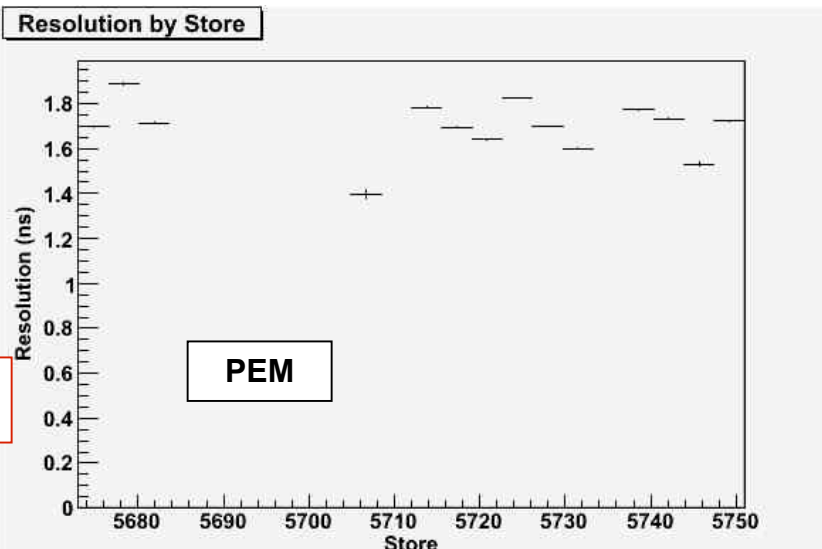
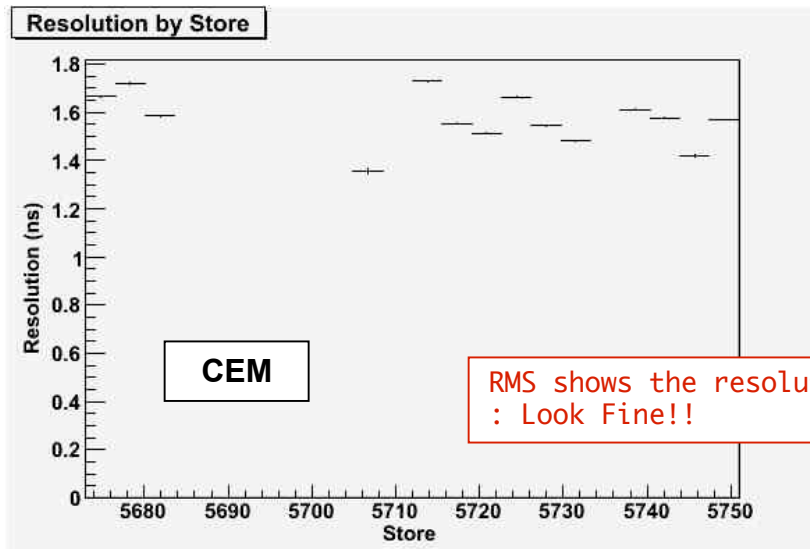




# Validation of the Calibration-cont.



Mean shifts are due to clock shifts  
Can be calibrated out



RMS shows the resolution  
: Look Fine!!

12/19/07

bphysr stream for runs 253092-254389.  
The calibrations cover the same range including all channels.



# Conclusions



- Hardware is working well
- Calibrations are working well and uniform throughout the system
- Uniform response as a function of run(store)
- Ready for analysis