

# Trigger Timing Comparisons

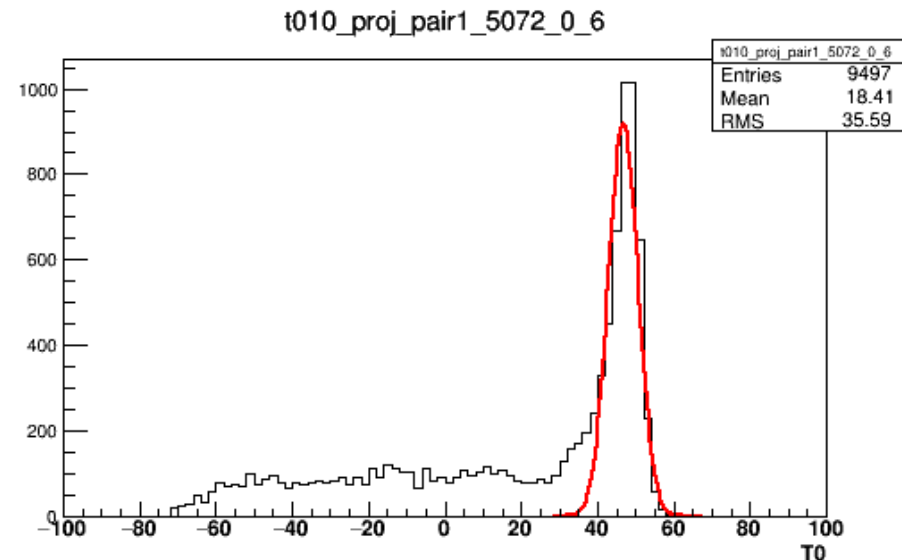
Matt Solt  
6/2/2015  
Stanford University

# Goals and Motivation

- Explore and predict the relationships between trigger times of the Ecal and the recorded hit times in the sensors
- Which clocks affect the phase shifts in the trigger?
- Are there trigger phase shifts between runs?
- Do we see any trigger jitter and under what circumstances?
- “Complete” comparison of fitted T0 mean and RMS for different phases of the clock cycle
  - Phases: Each phase of %6, %12, %24
  - Runs: 5072, 5150, 5153, and 5189
  - Triggers: Pair1, Pair0, Single1, and Single0

# Method

- T0 in each event
  - Looped over tracks, then stereo hits, then helical track strip clusters. Grabbed raw hit time as T0.
- Ran over 100,000 events (takes ~30-35 hours)
- Applied some relative time cuts, no absolute time cuts
  - Neighbor strip hits  $< 8$  ns
  - Helical tracker hits  $< 16$  ns
  - Track rms time cut  $< 8$  ns
  - No absolute cluster time cut



# Sample Bottom SVT T0 Fits

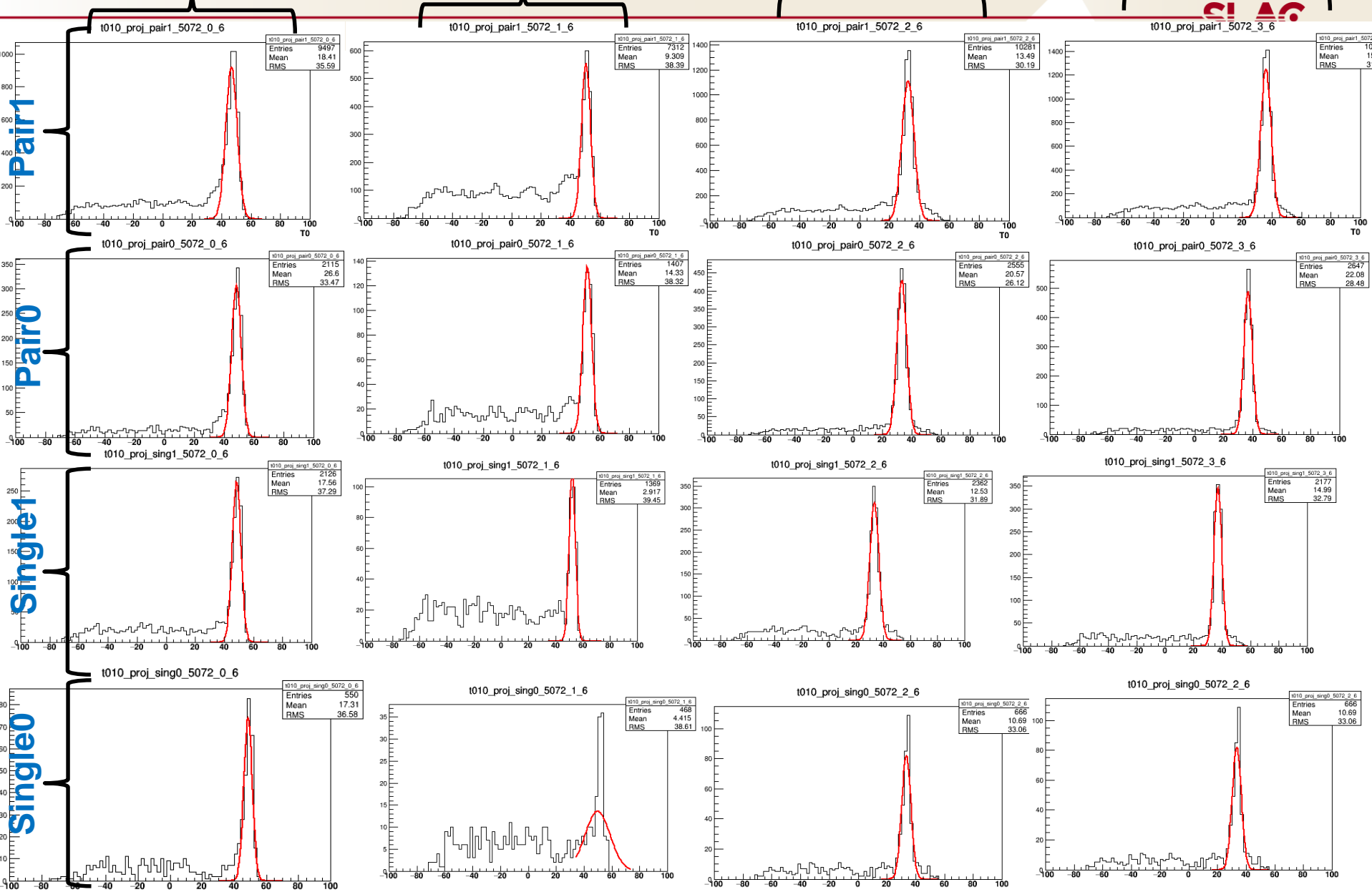
Phase 0

Phase 1

Phase 2

Phase 3

SLAC



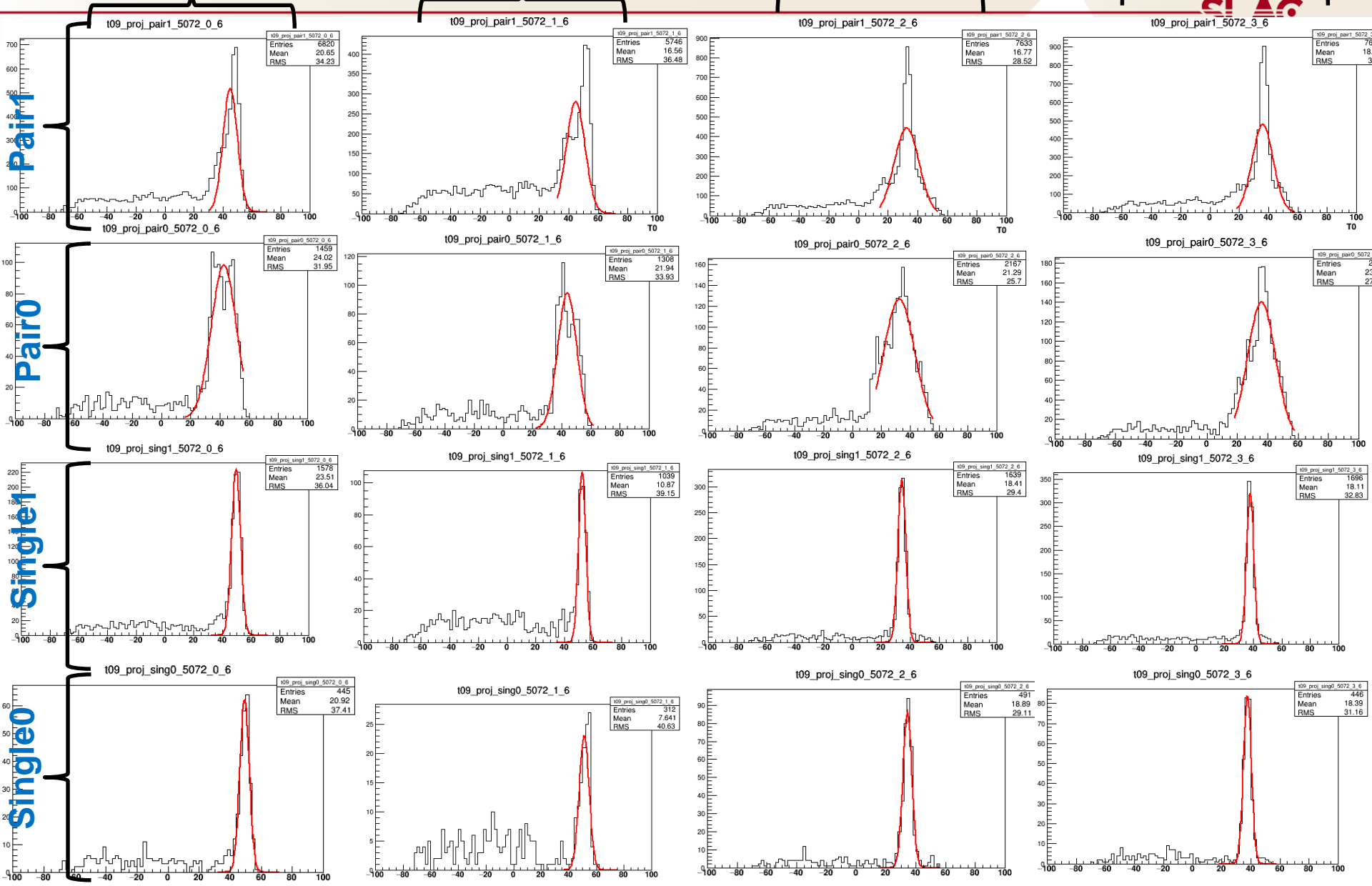
# Sample Top SVT T0 Fits

## Phase 0

## Phase 1

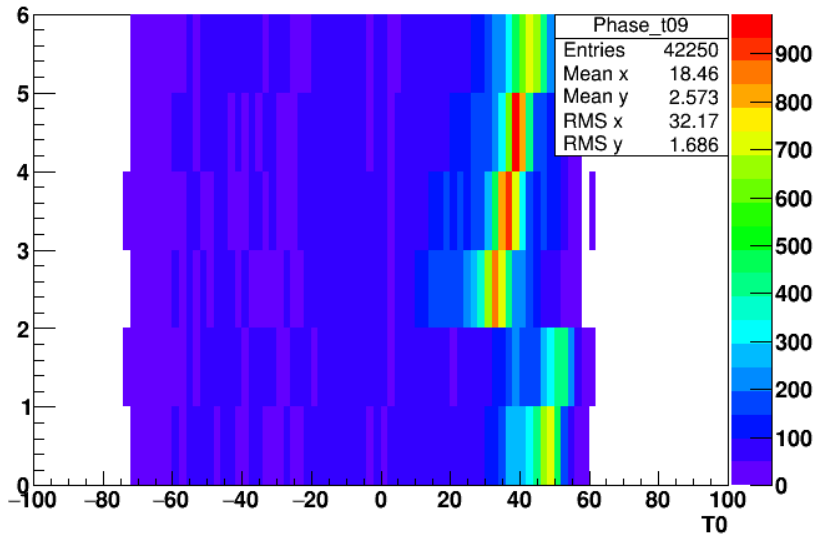
## Phase 2

## Phase 3

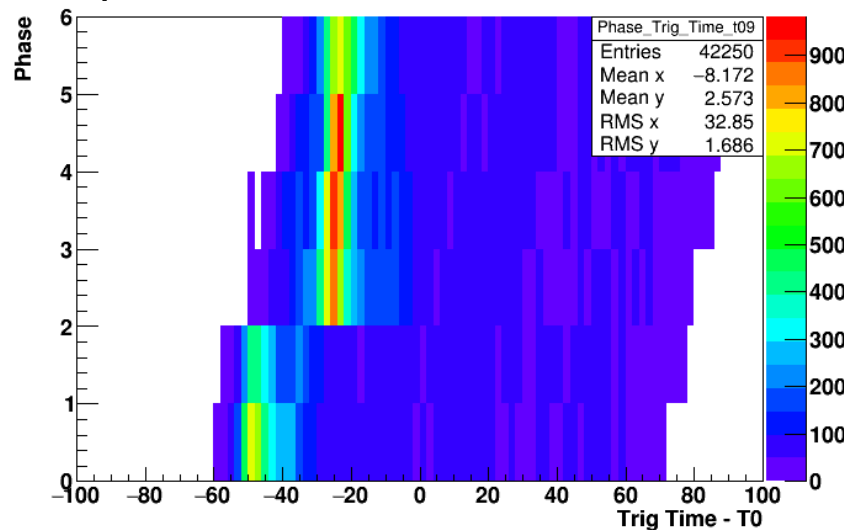


# Example T0 and Subtracted Trigger Time Phase Plots

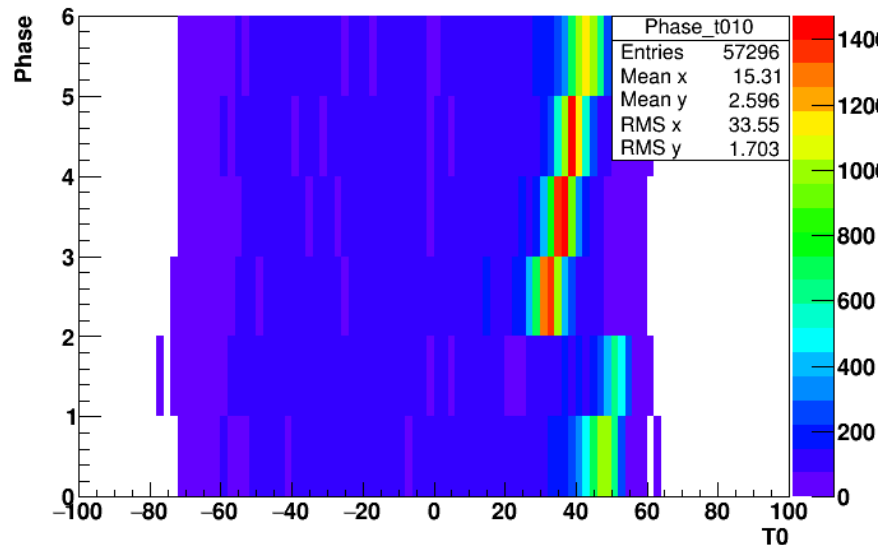
Top T0 Phase Plots (% 6) File 5072 Pair1



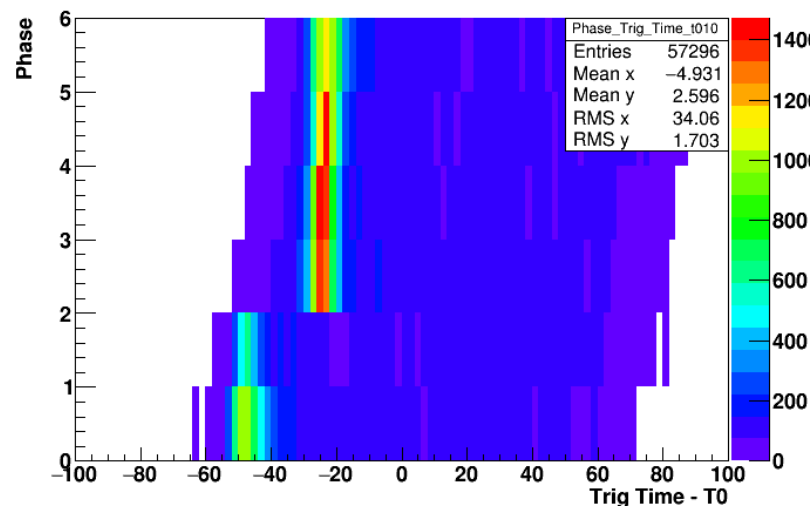
Top Trig Time - T0 Phase Plots (% 6) File 5072 Pair1



Bottom T0 Phase Plots (% 6) File 5072 Pair1

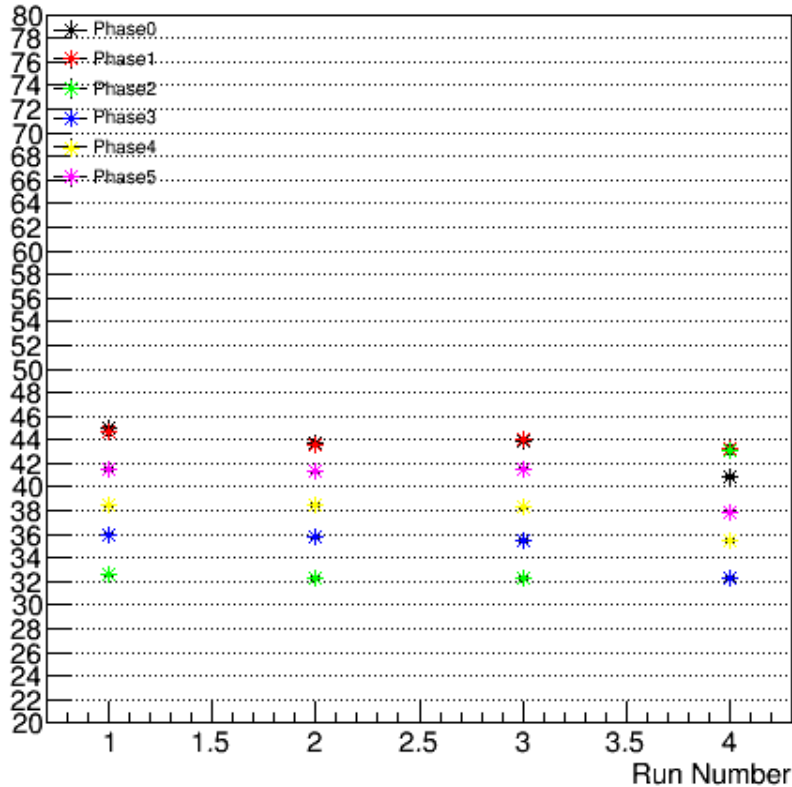


Bottom Trig Time - T0 Phase Plots (% 6) File 5072 Pair1

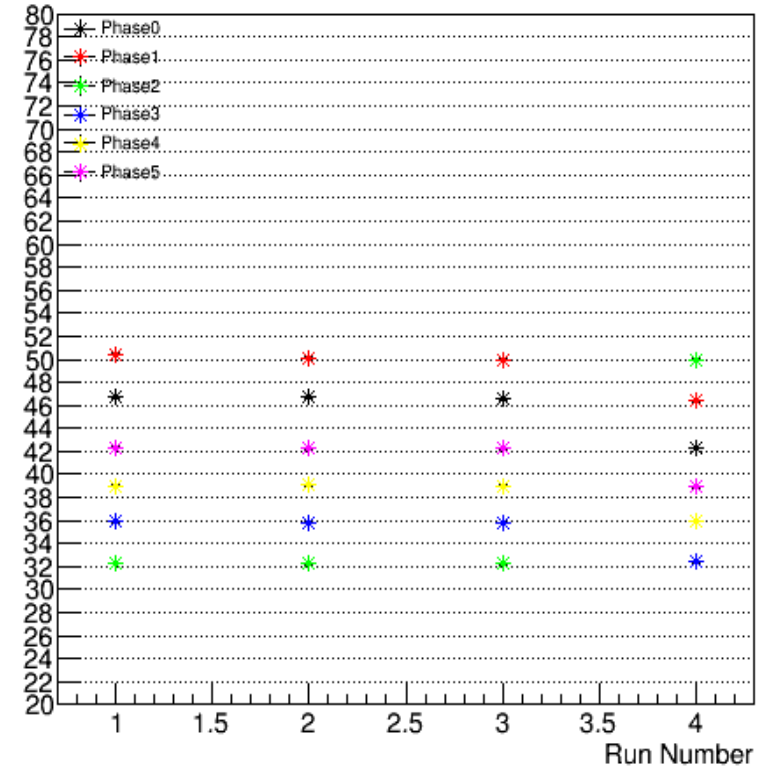


# Comparison of Mean T0 Between Runs - Pair1 Trigger

Top Mean T0 Pair1 Phase 0-5 (%6)



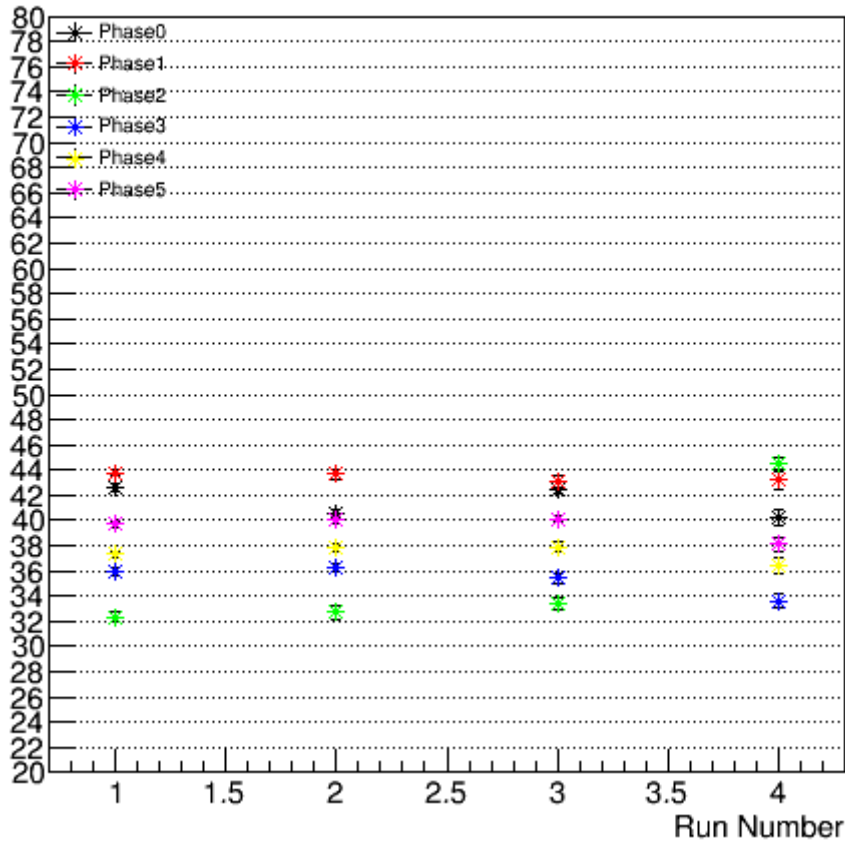
Bottom Mean T0 Pair1 Phase 0-5 (%6)



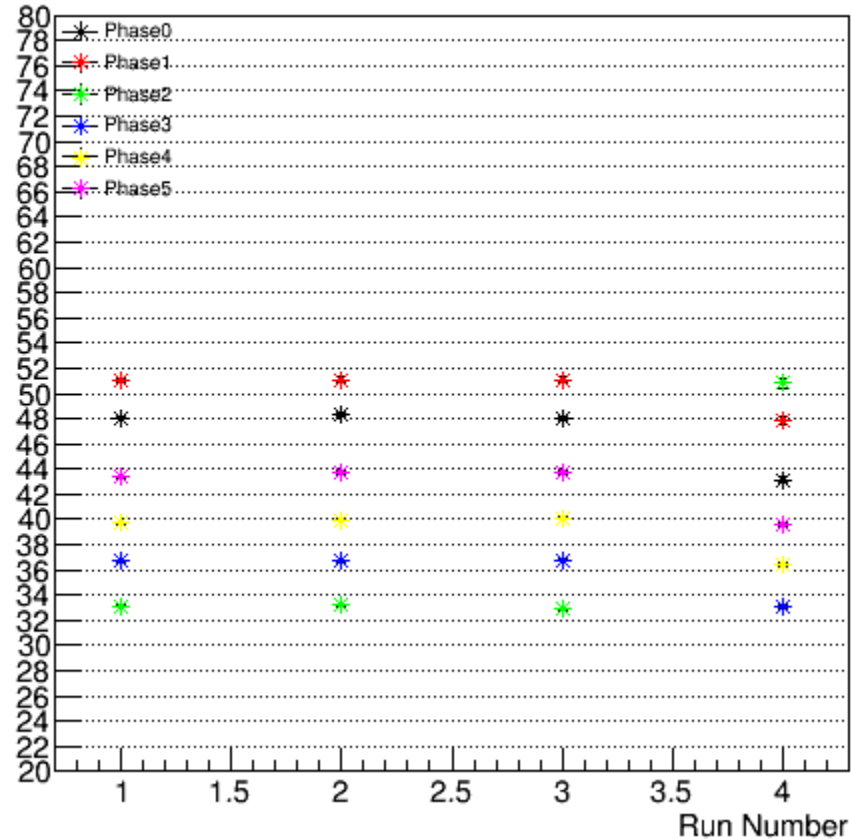
- 4 ns T0 shift for each phase, 24 ns T0 shift after 6 phases
- Run 4 is shifted 4 ns from the other runs

# Comparison of Mean T0 Between Runs – Pair0 Trigger

Top Mean T0 Pair0 Phase 0-5 (%6)



Bottom Mean T0 Pair0 Phase 0-5 (%6)

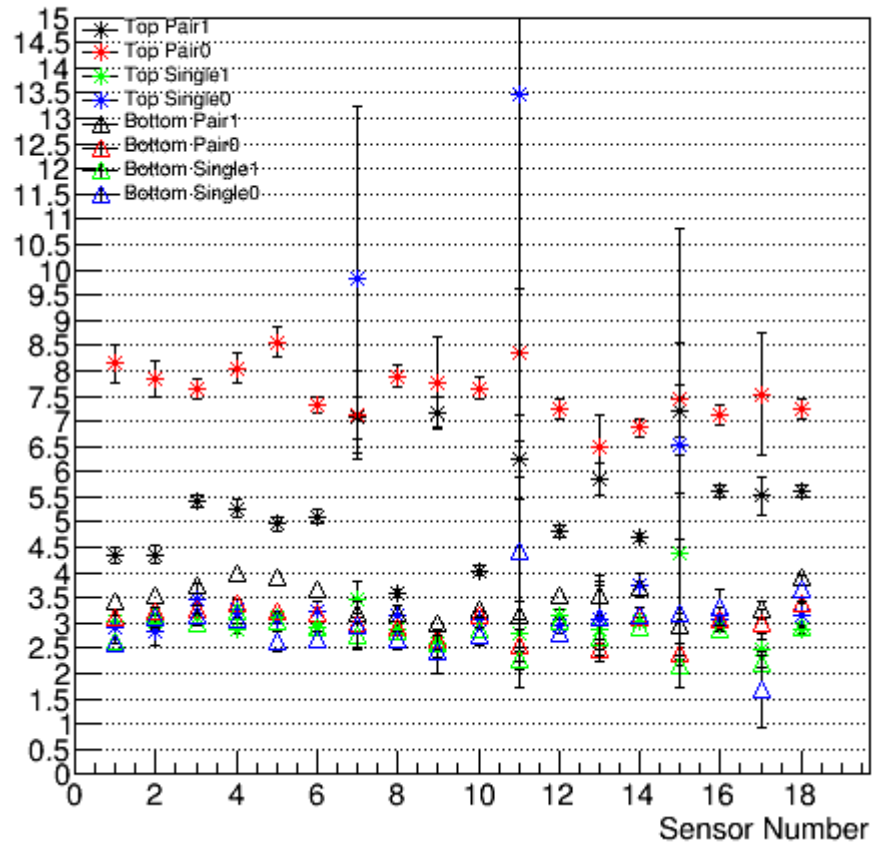


- Similar result for Pair0 trigger, and Single triggers



# Comparison T0 RMS for All Triggers of All Sensors

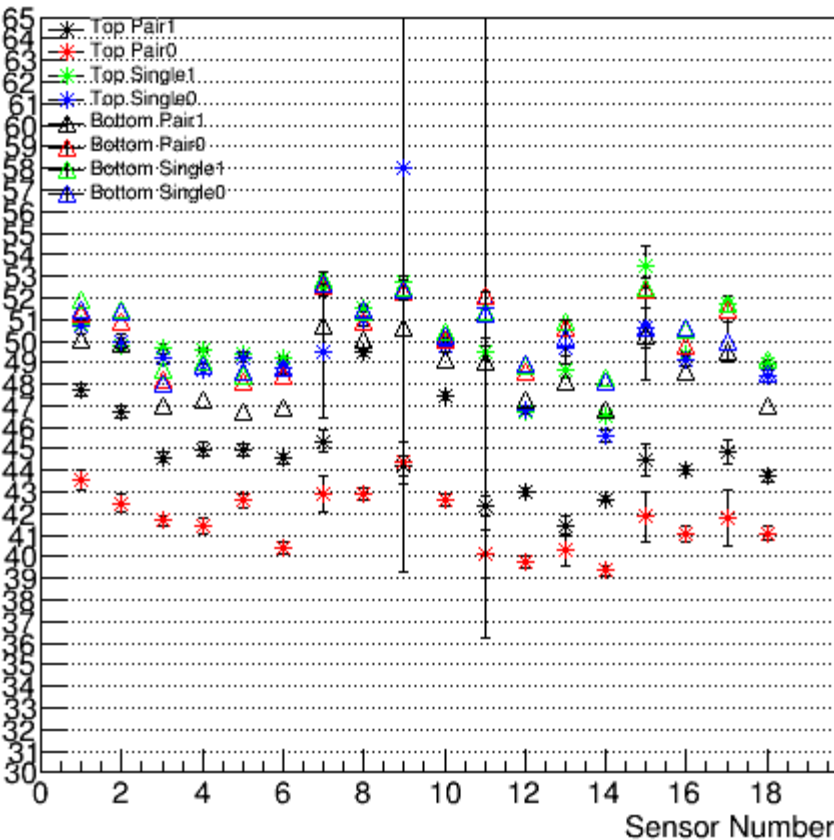
RMS T0 Phase 0



- Comparison between Top SVT and Bottom SVT
- Single triggers and bottom triggers display similar RMS
- Top Pair triggers show jitter
- Other runs and other phases show similar results

# Comparison T0 Mean for All Triggers of All Sensors

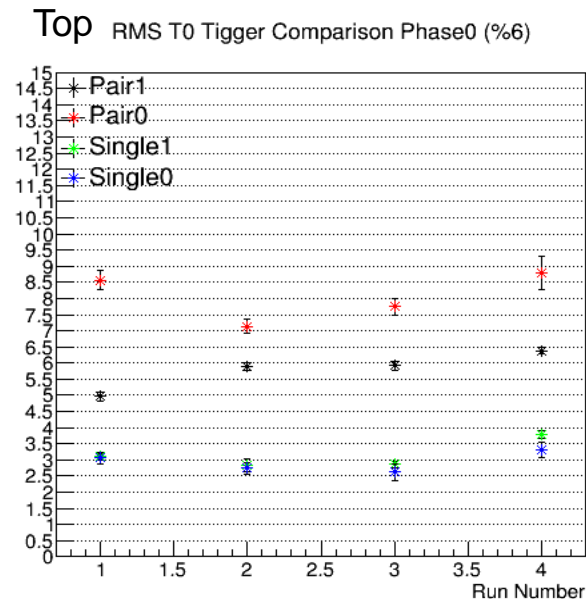
Mean T0 Phase 0



- Comparison between Top SVT and Bottom SVT
- Single triggers and bottom triggers display similar RMS
- Top Pair triggers display pileup effects
- Other runs and other phases show similar results

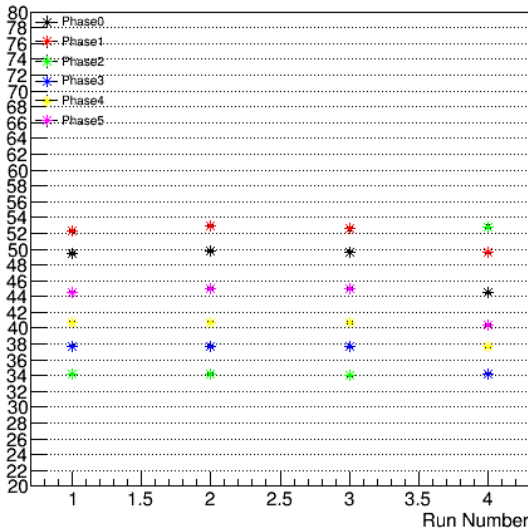
# Conclusion

- Trigger times are only affected by the 250 MHz master clock and 41.6 MHz clock, not the 125 MHz clock
- There can be 4 ns phase shift in the trigger between runs
- Trigger jitter is most present for the Top SVT Pair triggers
- Pileup is observed in Top SVT Pair triggers
- Look at more runs?

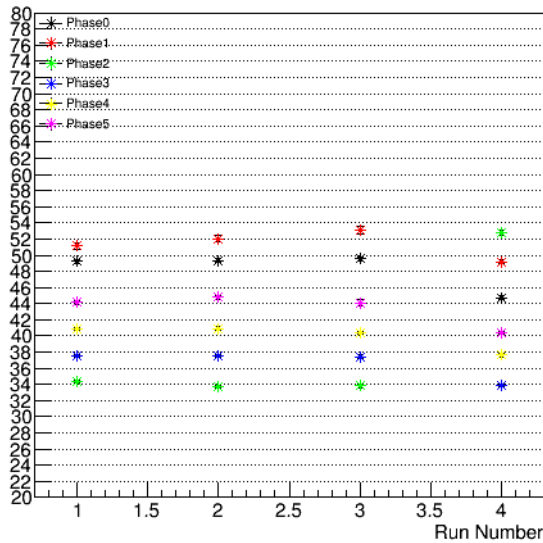


# Supplemental Slide – Mean T0 Between Runs Single Triggers

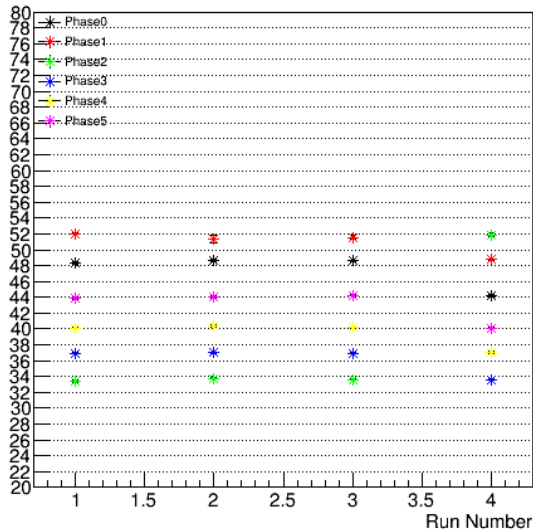
Top Mean T0 Sing1 Phase 0-5 (%6)



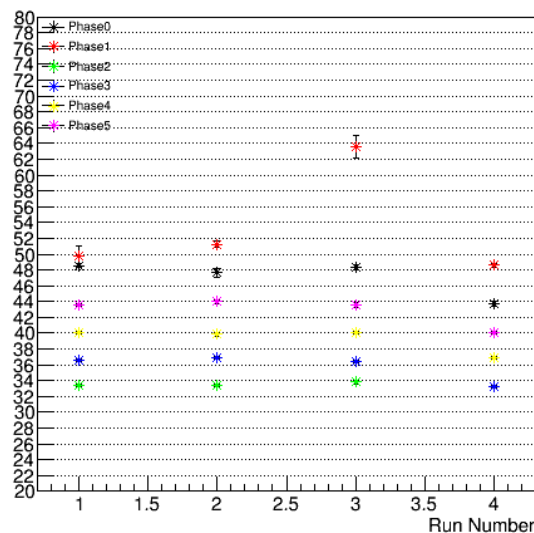
Top Mean T0 Sing0 Phase 0-5 (%6)



Bottom Mean T0 Sing1 Phase 0-5 (%6)

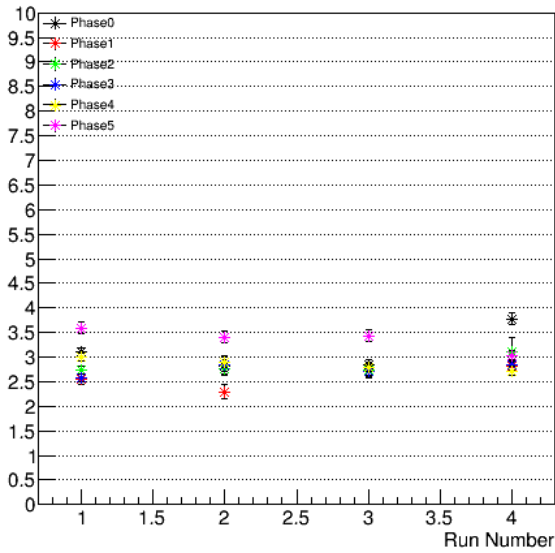


Bottom Mean T0 Sing0 Phase 0-5 (%6)

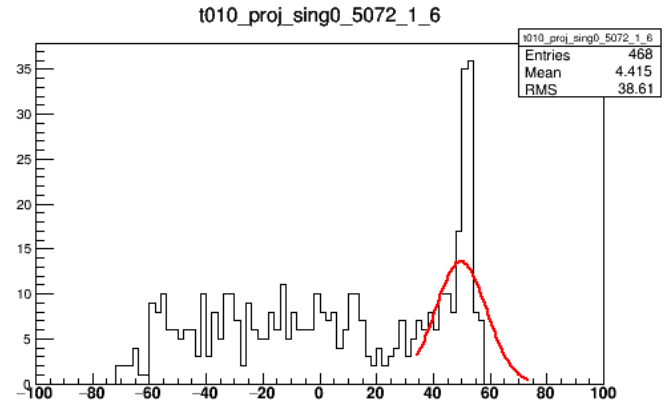
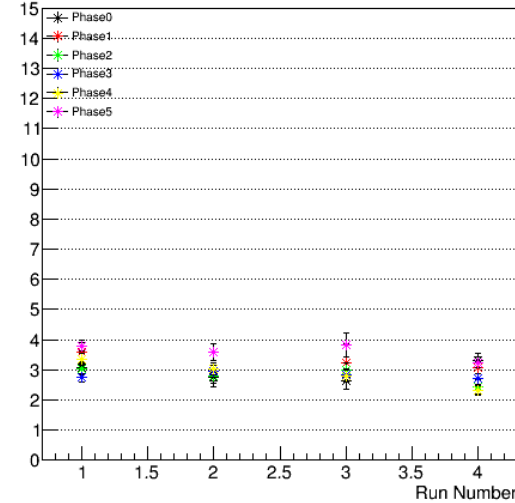


# Supplemental Slide - Comparison of RMS T0 Between Runs – Single 0-1 Trigger

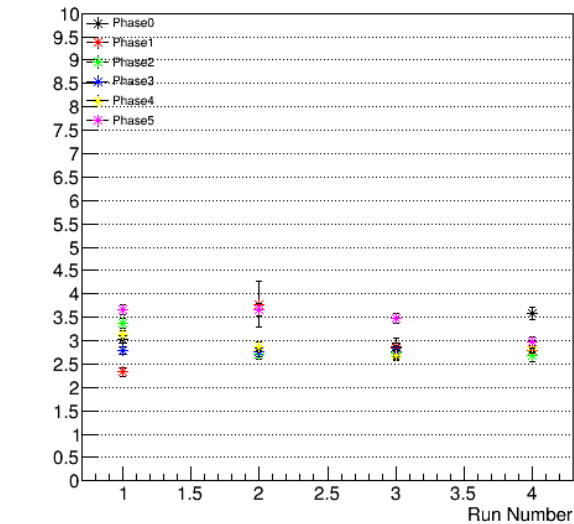
Top RMS T0 Sing1 Phase 0-5 (%)



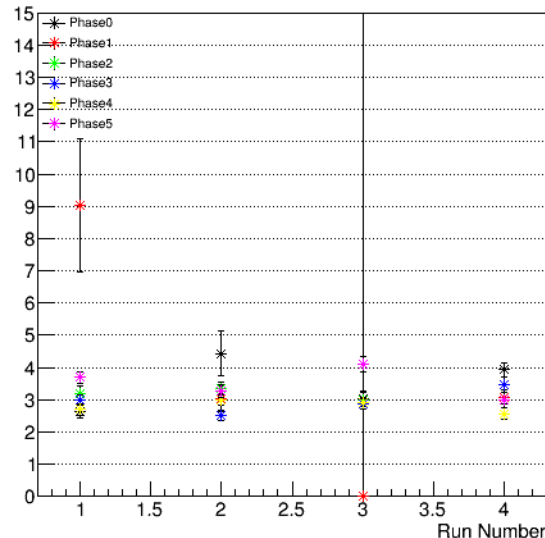
Top RMS T0 Sing0 Phase 0-5 (%)



Bottom RMS T0 Sing1 Phase 0-5 (%)

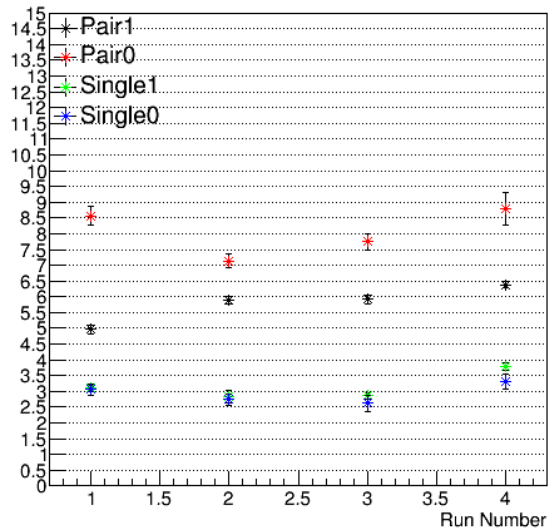


Bottom RMS T0 Sing0 Phase 0-5 (%)

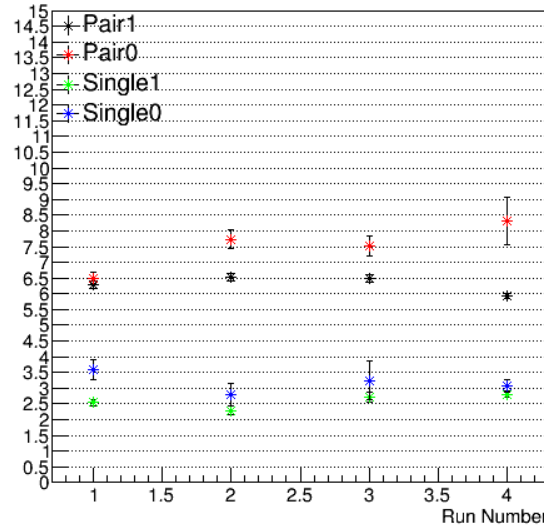


# Supplemental Slide – RMS Comparison for Various Triggers Across Runs

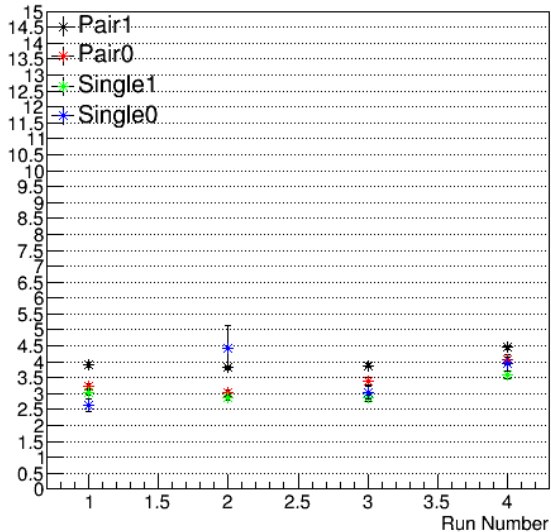
Top RMS T0 Tigger Comparison Phase0 (%6)



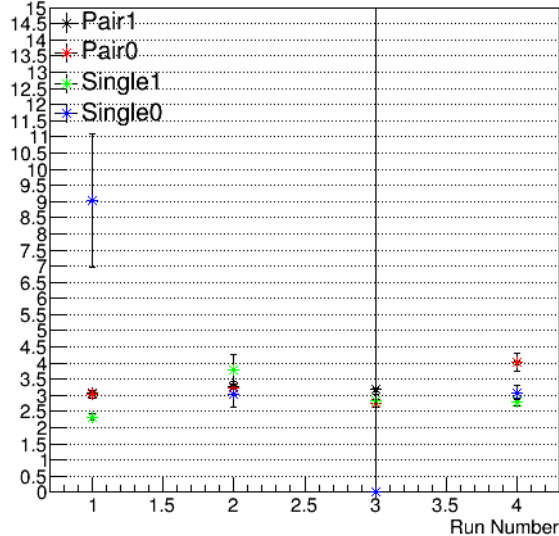
Top RMS T0 Tigger Comparison Phase1 (%6)



Bottom RMS T0 Tigger Comparison Phase0 (%6)

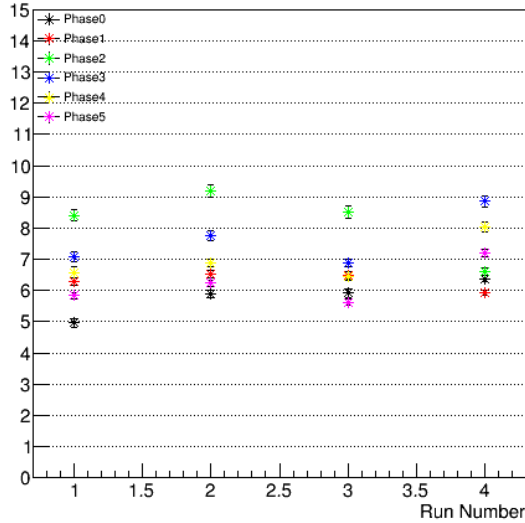


Bottom RMS T0 Tigger Comparison Phase1 (%6)

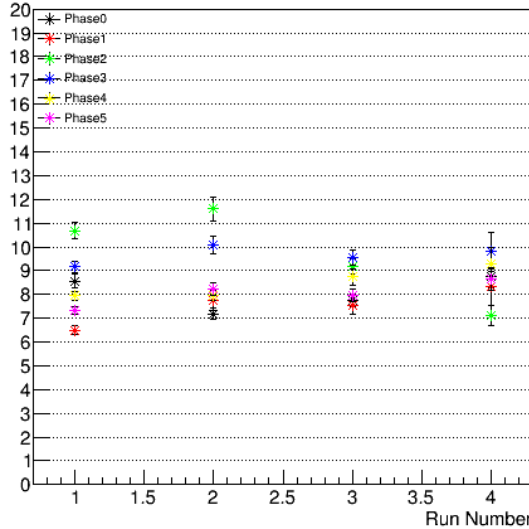


# Supplemental Slide – Comparison of RMS T0 Between Runs – Pair0-1 Trigger

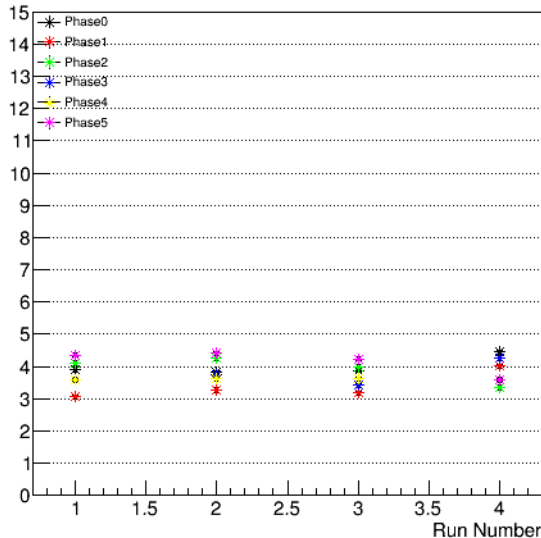
Top RMS T0 Pair1 Phase 0-5 (%6)



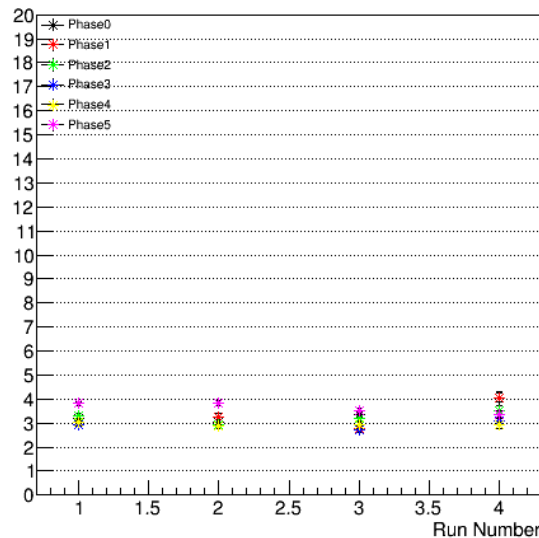
Top RMS T0 Pair0 Phase 0-5 (%6)



Bottom RMS T0 Pair1 Phase 0-5 (%6)

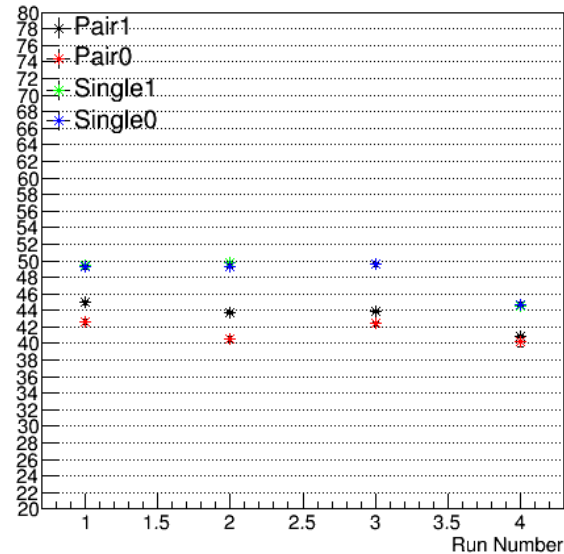


Bottom RMS T0 Pair0 Phase 0-5 (%6)

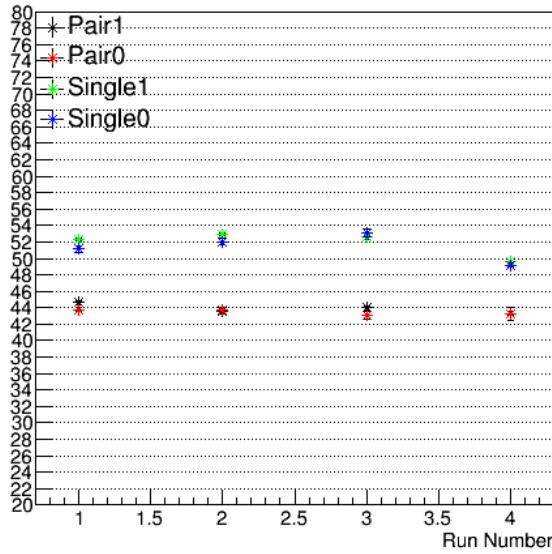


# Supplemental Slide – Comparison of RMS T0 Between Runs and Triggers

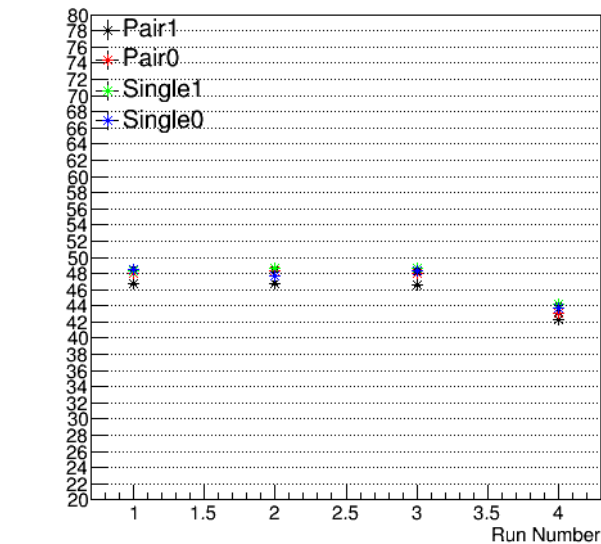
Top Mean T0 Tigger Comparison Phase0 (%6)



Top Mean T0 Tigger Comparison Phase1 (%6)



Bottom Mean T0 Tigger Comparison Phase0 (%6)



Bottom Mean T0 Tigger Comparison Phase1 (%6)

