

# New WCD+SSD Triggers (Work in Progress)

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# Descriptions of the Triggers

All of the new triggers operate in full bandwidth mode

- DL (Direct Light)
  - Looks for a signal in a bin followed by a sharp decrease in the next bin.
  - The bin after peak must be  $< 5/16$  of the peak && the peak must be  $> 400$  counts.
- EM (Electromagnetic)
  - Looks for a signal spread in time in either the WCD or SSD
    - EMLevelVEM 0.2
    - EMLevelMIP 0.5
    - EMLookBackWCD 35
    - EMLookBackSSD 6
    - EMMinSpreadWCD 70
    - EMMinSpreadSSD 12
    - EMMultiplicity 2
- EMInt (Electromagnetic integral)
  - Looks for a relatively large integrated signal in the SSD
    - EMIntPct 80
    - EMIntInt 300

# Background Trigger Rates

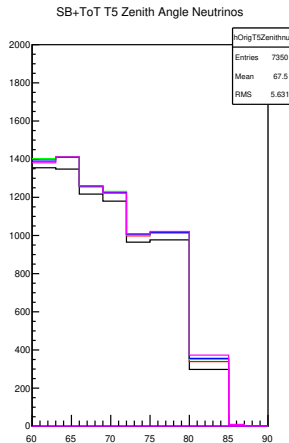
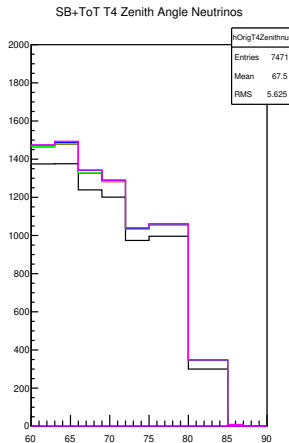
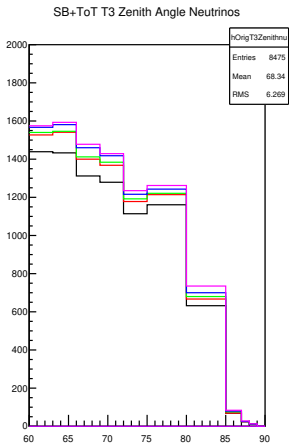
Rate	SB	ToT	ToTD	MoPS	DL	EM	EMInt
Hz	23.4	2.2	0.7	1.5	2.0	2.9	2.2
Excess Hz					2.0	2.0	2.2

Background trigger rates measured using Nadia randoms from March, 2023.

- Trigger parameters are tuned so that background trigger rates are comparable to ToT
- No guarantee this is optimal for physics triggers

# Progress on New Triggers Offline Simulations (3 EeV $\nu$ )

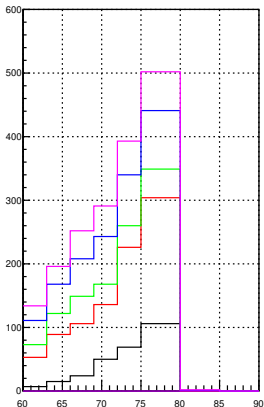
- Vertical scale is  $\#T3/T4/s$  in (arbitrary units)



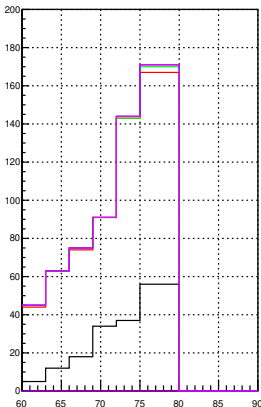
- Color code: SB+ToT SB+ToT+ToTD SB+ToT+ToTD+MoPS SB+ToT+ToTD+MoPS+DL SB+ToT+ToTD+MoPS+DL+EM SB+ToT+ToTD+MoPS+DL+EM+EMInt (missing due to bug)

# Progress on New Triggers Offline Simulations (0.1 EeV $\nu$ )

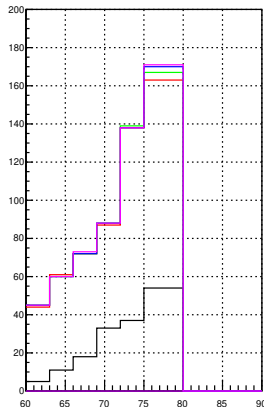
SB+ToT T3 Zenith Angle Neutrinos



SB+ToT T4 Zenith Angle Neutrinos



SB+ToT T5 Zenith Angle Neutrinos



- Color code: SB+ToT SB+ToT+ToTD SB+ToT+ToTD+MoPS SB+ToT+ToTD+MoPS+DL SB+ToT+ToTD+MoPS+DL+EM SB+ToT+ToTD+MoPS+DL+EM+EMInt (missing due to bug)

# Some Issues

- This all very much a work in progress!
- Zenith angle bins  $> 80^\circ$  not properly normalized to those  $< 75^\circ$
- Zenith angle bin width not accounted for in histograms
- What is displayed is first complete pass that has all of
  - Offline triggers agree with reference triggers
  - Reference triggers agree with FPGA triggers
  - Background trigger rate (from Nuria randoms data) acceptably low
- Why do increase in T3's not translate to increase in T4 and T5s?
  - Accidentals? How to suppress preferentially (without reducing efficiency for real showers)
  - Missing changes to Offline wrt T4/T5? This is first time T4/T5 have been included in the simulations
- What to do next?
  - Inspect triggered events to identify how background triggers can be reduced
  - Identify what would be needed to promote non-triggered stations to triggered ones