

Trigger efficiency studies

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Old results (as shown 6/12/12)

- Run 1351, 508853 total events:

Simulated trigger:	none	top	bottom	both
Top trigger bit:	774	270003	2	1654
Bottom trigger bit:	8125	2	224070	1259
Both trigger bits:	0	5	6	2953

- Looks bad if you look at efficiency, unbiasing by requiring top trigger bit and checking for bottom:

Bottom:	should have fired	shouldn't have fired
fired	$6+2653 = 2659$	$0+5 = 5$
didn't fire	$2+1654 = 1656$	$774+270003 = 270777$

Some details of triggering and readout

- FADC computes pulse integral two ways:
 - ▶ For trigger, integrates time-over-threshold
 - ▶ For DAQ, integrates a fixed time window much wider than the pulse (5 samples before, 30 after)
- Readout hit integral is linear in the hit amplitude; trigger hit integral is not
 - ▶ Low-energy hits have significantly smaller trigger hit integrals than readout hit integrals, so if you try to do trigger studies using readout hit integrals it'll look like low-energy hits are getting lost in the clusterer
 - ▶ Readout threshold is less than trigger threshold, so we always know whether there was a trigger hit
- Data contains readout hits, so a correct trigger simulation needs to convert readout hit integrals to trigger hit integrals
 - ▶ Wasn't done for 6/12/12 results because it's difficult to do accurately, and isn't necessary if you're just checking timing — didn't realize how significant the effect was

Applying the correction

- Need pulse shape (CR-RC, shaping time 14 ns for now), trigger threshold (80 ADC counts above pedestal), readout hit integral
 - ▶ Integrate pulse shape to get the pulse amplitude
 - ▶ Do the time-over-threshold integration to get the trigger hit integral
- The rest of the trigger algorithm (truncate, cluster, trigger) proceeds as usual
- This is only exact if you know the time of the hit relative to the FADC clock (which we don't); since the pulse rise time is only a few clocks, this actually matters

New results

- Haven't actually calibrated the pulse shape; it has a large effect on these efficiencies (14 ns is basically just a guess)

Simulated trigger:	none	top	bottom	both
Top trigger bit:	2457	269600	3	373
Bottom trigger bit:	9593	1	223502	360
Both trigger bits:	0	16	12	2936

Bottom:	should have fired	shouldn't have fired
fired	2948	16
didn't fire	376	272057

Top:	should have fired	shouldn't have fired
fired	2952	12
didn't fire	361	233095

Next steps

- Calibrate pulse shapes using window-mode data
- Hit time information's not recoverable, so we're just going to have to compare rates against MC to get efficiencies