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Name of the exercise

Detector and Trigger: Scintillators, trigger logic, input to readout modules (ADC & TDC)

Responsible for the exercise

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Description of the exercise

The aim of the exercise is to get an understanding of the detector and trigger logic used in exercise # 4. The signals from two scintillation counters are analysed and used to build a trigger based on a coincidence between the signals. In addition the inputs to the readout modules (QDC and TDC) are setup.

What will the students learn

- cabling up a scintillator (HV and signal)
- using a scope to measure the properties of a signal
- using typical NIM modules (discriminator, scaler, coincidence unit)
- setting up the coincidence logic (trigger).
- prepare analogue and NIM signals to readout modules (QDC and TDC).

Duration

2 hours

List of material

- two complete scintillation counters (scintillator, light guide, PM, base, shielding)
- NIM Crate + power supply
- CAEN N470 four channel high voltage power supply
- CAEN N145 Quad Scaler
- LeCroy Quad Discriminator 621 L
- LeCroy Coincidence Unit 465
- small screwdriver (to adjust threshold & pulse width on the LeCroy units)
- two delay units
- oscilloscope
- voltmeter
- Lemo cables

Relevant information

- a diagram of the setup for exercices 3 and 4 is shown in: ScintillatorDaqSchool.pdf
- a picture of the NIM crate is shown in: NIMCrate.pdf

Instruction sheet

- **general note: whenever there are two parallel outputs from a (NIM) module make sure that they are both cabled i.e. either terminated with 50 Ohm or connected to another unit. This ensures that the pulses have the correct NIM voltage levels: 0 and -0.8 Volts**

1. install the scintillation counters close to each other with maximum overlap between the scintillator areas.
2. check that the scintillator PM bases are connected to the N470 NIM high voltage supply
3. switch ON the NIM crate
4. connect an output from scintilator # 0 to an oscilloscope(10ns LEMO), terminate the other output with 50 Ohm.
5. set the nomimal high voltage on scintillator # 0 using channel 0 of the N470 HV supply. The voltage is marked on the label glued onto the base. N470_ShortGuide.pdf
6. look at the signal on the scope(volts/div ~ 50 mV, time/div ~ 20ns). What is the maximum voltage of the signal?
7. connect the cable to the input of the first channel of the discriminator.
8. connect an output to the oscilloscope(0.5 Volts, 50 ns) and adjust the pulse width to around 100 ns using a small screwdriver.(terminate the other output with 50 Ohm), see NIMCrate.pdf.
9. connect the output to the first channel of the NIM scaler(N415) using a short LEMO cable(1ns).
10. set the discriminator threshold to around 50 mV: adjust the voltage on the test point using a DC voltmeter and a small screwdriver, see NIMCrate.pdf. The voltage is 10* the threshold value i.e. the voltage should be around 0.5 Volts. You may need three hands ...
11. what is the scaler rate?
12. vary the threshold around 50 mV and check the variations in scaler rate. Set the threshold such that the rate is ~ 200 Hz.
13. repeat points 4 to 11 above for scintillator #1 (replace first by second and 0 by 1 ...)
14. Given the scaler rates measured above, what is the probability of random(unphysical) coincidences between pulses from the two scintillators?
15. connect an output from each of the two discriminator channels to the oscilloscope and check that they have a timing overlap i.e are coincident
16. connect the cables from the discriminators to the first inputs of the coincidence unit (LeCroy 465) using short LEMO cables(1ns).
17. connect an output from the coincidence unit to a scaler input. What is the rate? Given that the rate of cosmic muons is about 100 per second per m**2, does the rate make sense?
18. connect an output of the coincidence unit to channel 1 of the oscilloscope
19. connect the (other) analogue output from scintillator #0 to a delay unit (LEMO 10ns) and the output of the delay unit to channel 2 of the oscilloscope.
20. using channel 1 as a trigger, observe the analogue signal on channel 2. Channel 2 will then show the scintillator signals for the cosmic muons. Assuming that the signal is triangular, what is the charge of the signal, see ChargeOfPulse.pdf
21. adjust the delay unit such that the analogue signal falls within the NIM pulse from the coincidence: inputs to the QDC in exercise # 4 are now ready (analogue + gate)
22. repeat points 18 to 20 for scintillator #1.
23. connect a cable from the first discriminator to channel 2 of the oscilloscope and check the timing wrt the output from the coincidence (channel 1), the signal from the discriminator should precede the coincidence. Similarly for the second discriminator. The inputs to the TDC in exercise 4 are now prepared(trigger + timing signals).

24. the signals from the discriminators are sometimes about twice as long as expected. What could the reason be?

Solution

TBD

- point 13 about probability. E.g. scintillator 0 rate, rate0 = 200 Hz, scintillator 1 rate, rate1 = 400 Hz, pulse width = 100 ns. The probability of "hitting" a pulse from scintilator 0 within one second is 200 Hz * 100ns/1 sec = 2/100000. The probability of a random coincidence is then 400 Hz * 2/100000 = 8/1000 ~1 %.
- I = V/R ~ 250 mV/50 Ohm = 5 mA. Q = I * t = 5 mA*10 ns = 50 pC.
- the analogue signals from the PM have a shape where they could possibly trigger the discriminator twice

-- JorgenPetersen - 2009-08-24

This topic: Sandbox > DaqSchoolExercise3
Topic revision: r22 - 2010-01-25 - MarkusJoos