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Implementation of a double trigger condition system based on Charge Comparison and TOF measurement for the NEDA detector array

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Abstract

The NEutron Detector Array (NEDA)[1] is designed to be coupled to gamma-ray spectrometers to enhance the sensitivity of the setup by enabling reaction channel selection by counting evaporated neutrons[2,3]. This poster presents the implementation of a Double Trigger condition system for NEDA, allowing for improved acquisition of neutrons and reducing the number of gammas acquired. Two independent triggers are generated: one is based on Charge Comparison (C.C.) and another on Time-Of-Flight (TOF). These trigger modes are combined using OR and AND logic, offering four distinct trigger modes. This study shown that most detected neutrons are preserved with AND mode, and the total number of gammas is significantly reduced. On the other hand, the OR trigger mode allows increasing the selection of neutrons, compared to the C.C. trigger mode. In addition, it is demonstrated that if the OR mode is selected, the online C.C. trigger threshold can be raised without losing neutrons.

Introduction

NEDA is a neutron detector based on a liquid scintillator that provides efficient neutron-gamma discrimination making use of the C.C. and TOF information.
The double trigger system offers 4 trigger modes:

- **C.C. mode: Only C.C.** triggered events are considered.
- **TOF mode: Only TOF** triggered events are considered.
- **AND mode:** Both **C.C. and TOF triggers** are required for event acquisition.
- **OR mode:** Either **C.C. or TOF trigger** allows event acquisition.

Firmware implementation

The core component of NEDA's electronics is the **NUMEXO2**[4] digitiser, housing Virtex6 and Virtex5 FPGAs.
The new trigger system, implemented within **Virtex6**, generates a final trigger after obtaining independent trigger signal.

In-beam results

The double trigger condition was **evaluated with data from E703 experiment performed at GANIL. The four triggers were applied to the same data**, and the offline analyses were performed. By counting the number of events in each area, the number of acquired events of each type were counted.

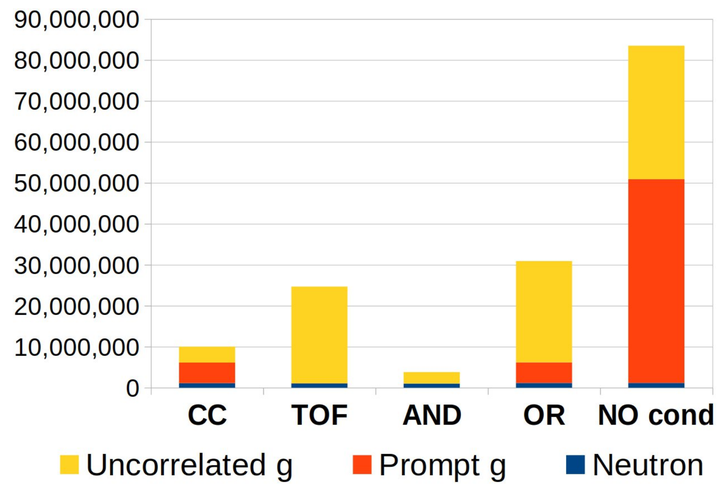

Figure 5. Number of events acquired with each trigger mode and for each type of particle.

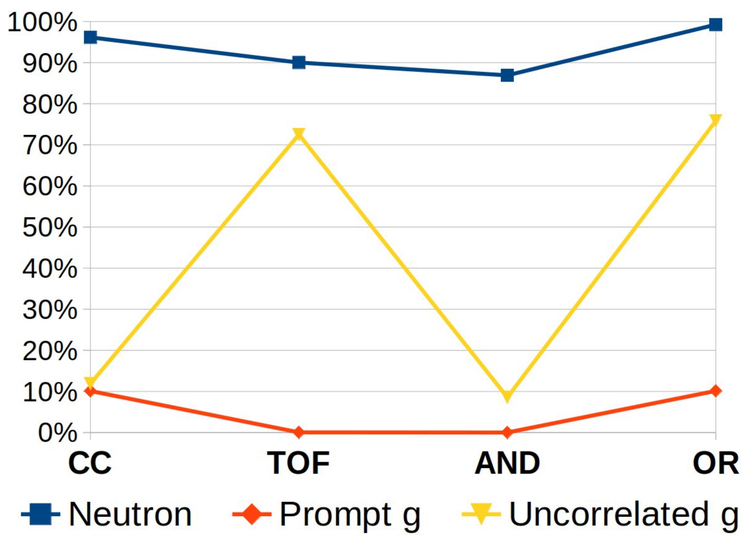

Figure 6. Percentage of events acquired by type of particle and by trigger mode compared to no trigger condition.

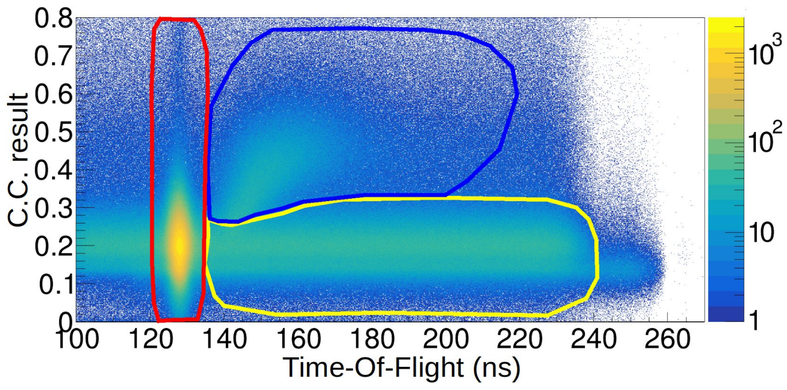

Figure 1. Event distribution using **C.C.** trigger mode.

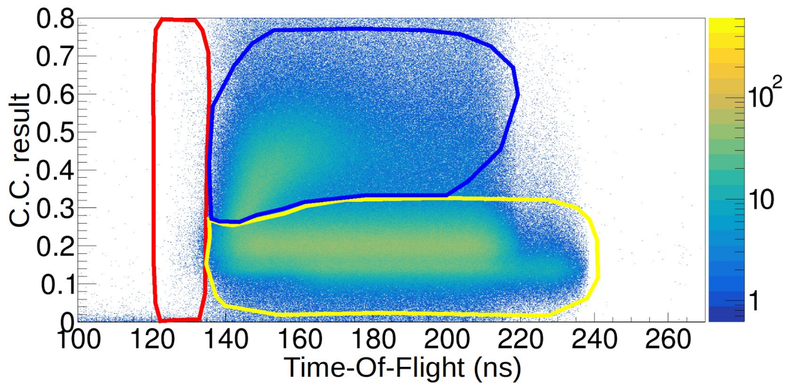

Figure 3. Event distribution using **AND** trigger mode.

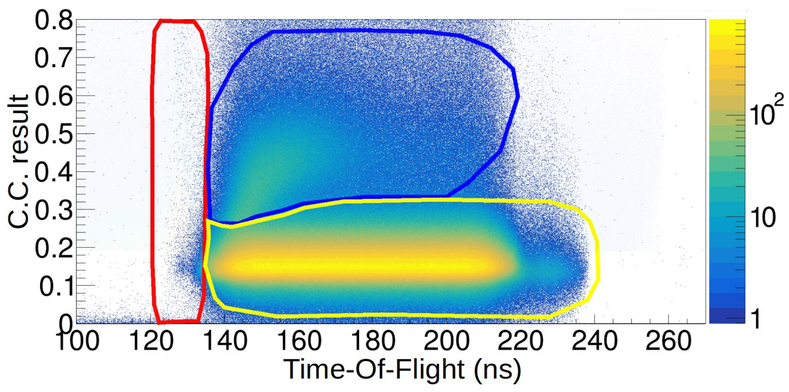

Figure 2. Event distribution using **TOF** trigger mode.

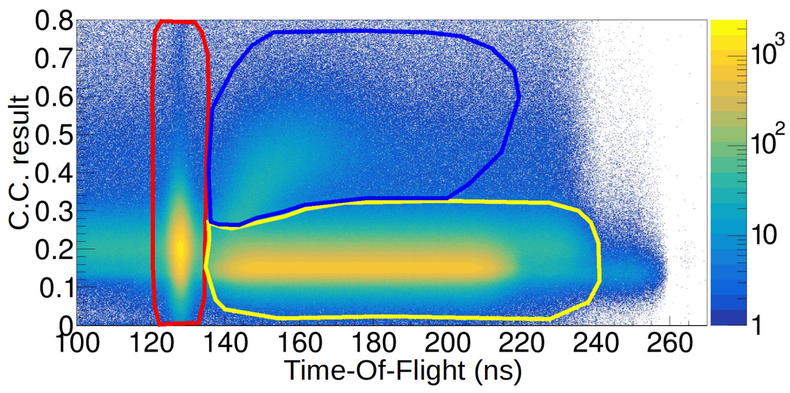

Figure 4. Event distribution using **OR** trigger mode.

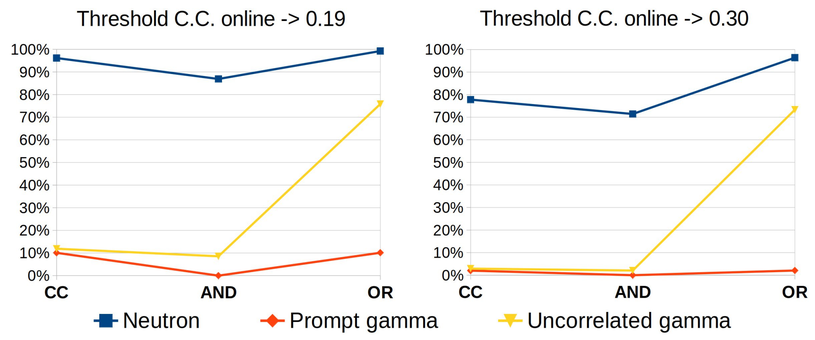

Figure 7. Percentage of events acquired compared to acquisition without trigger condition using different C.C. thresholds (0.19 and 0.30).

Conclusions

- The AND trigger mode is useful in experiments where the data acquisition system requires a **low level of trigger request**.
- The OR trigger mode is useful for **detecting low energy neutrons**.
- The OR trigger mode allows to **increase the C.C. threshold avoiding losing neutrons.**
- The double trigger condition system for the NEDA represents **a significant advancement in enhancing the capabilities of spectrometry setups, improving the precision and accuracy of reaction channel selection.**

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