



A software-based multiplicity trigger algorithm for HEP experiments

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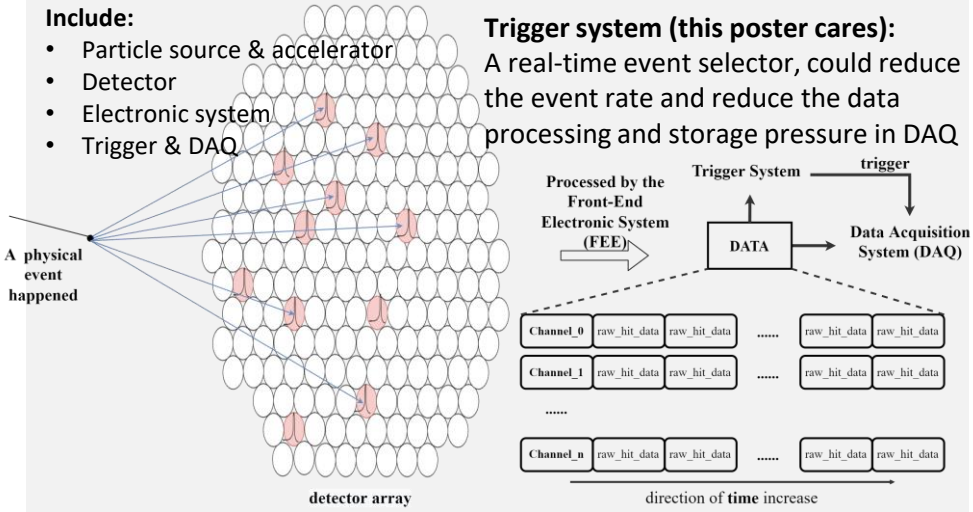
What does the HEP experiment usually contain?

Include:

- Particle source & accelerator
- Detector
- Electronic system
- Trigger & DAQ

Trigger system (this poster cares):

A real-time event selector, could reduce the event rate and reduce the data processing and storage pressure in DAQ



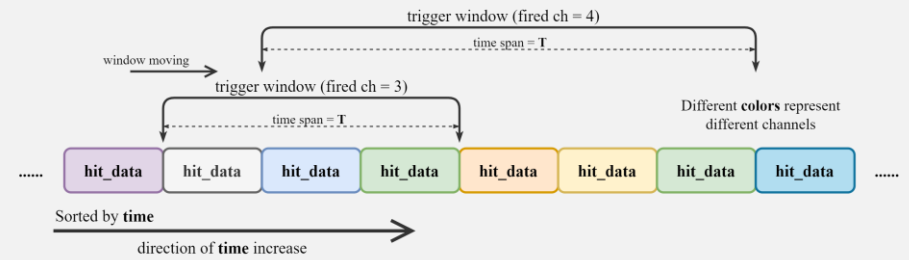
How does the multiplicity trigger work?

Select events by counting the number of fired detector channels in trigger window. Only events where the number of fired channels is greater than N can be triggered.

N: the trigger threshold

T: the time span of trigger window

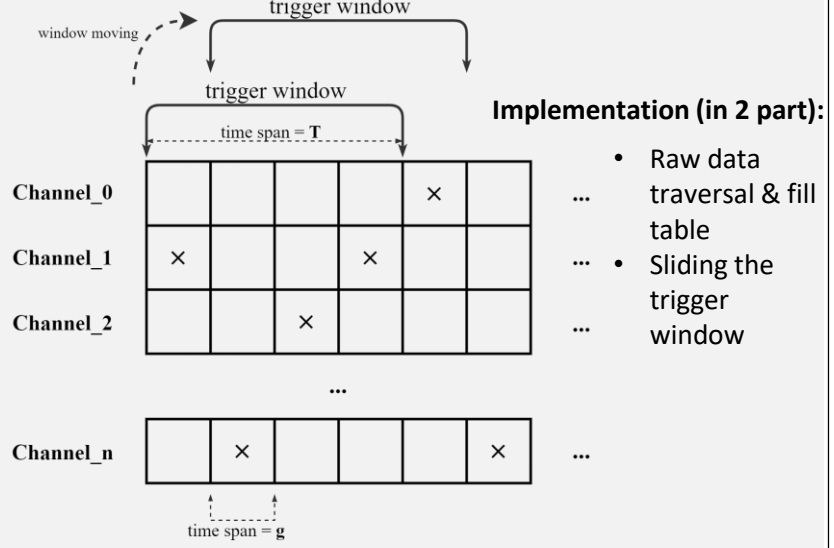
Trigger window: a time window with fixed time span



software implementation (in 3 part):

- Raw data traversal
- Sorting hit by time
- Sliding the trigger window

Another implementation of multiplicity trigger (using hit-table instead of sorting hit)



Implementation (in 2 part):

- Raw data traversal & fill table
- Sliding the trigger window

Hit-table, rows represent channels & columns represent a small period of time (span = g). When the channel is fired during this period of time, the corresponding position in the table is also marked. Without hits sorting, the new algorithm will have better computational efficiency in high hit rate scenarios.

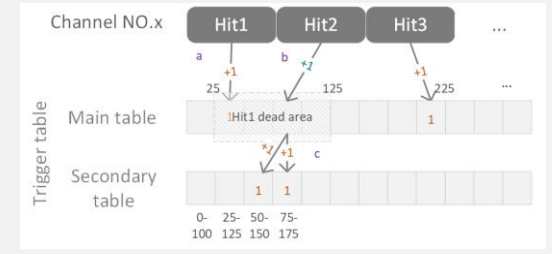
particularity:

- Table use fixed memory & sliding window take a fixed time
- Time complexity is O(n)
- The adjustment of g affects the trigger precision, the size of table and the time spent on the window sliding.

Shortcoming:

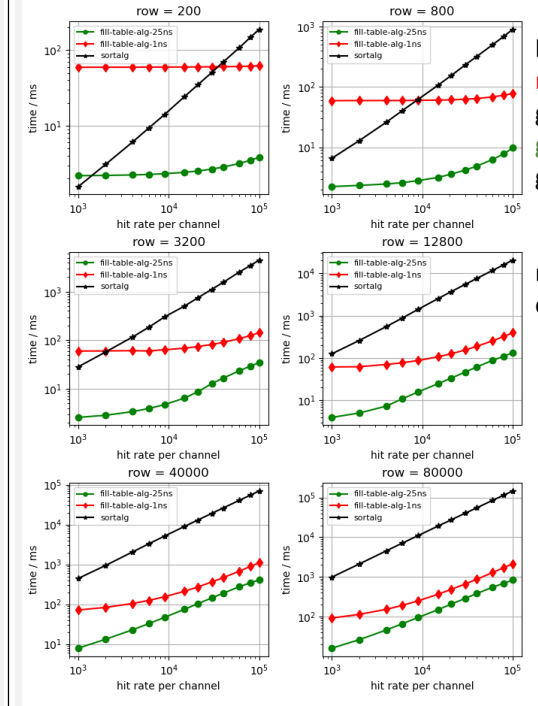
- Not suitable in low hit rate scenarios

Further improvements to hit-table



Only 2 rows of table could implement the function of the full-channel hit-table. More details are left in the article.

Computational performance test



black: using sorting

red: using hit-table, g=1ns

green: hit-table, g=25ns

row represent channel number