

Trigger development for BSM searches in ProtoDUNE



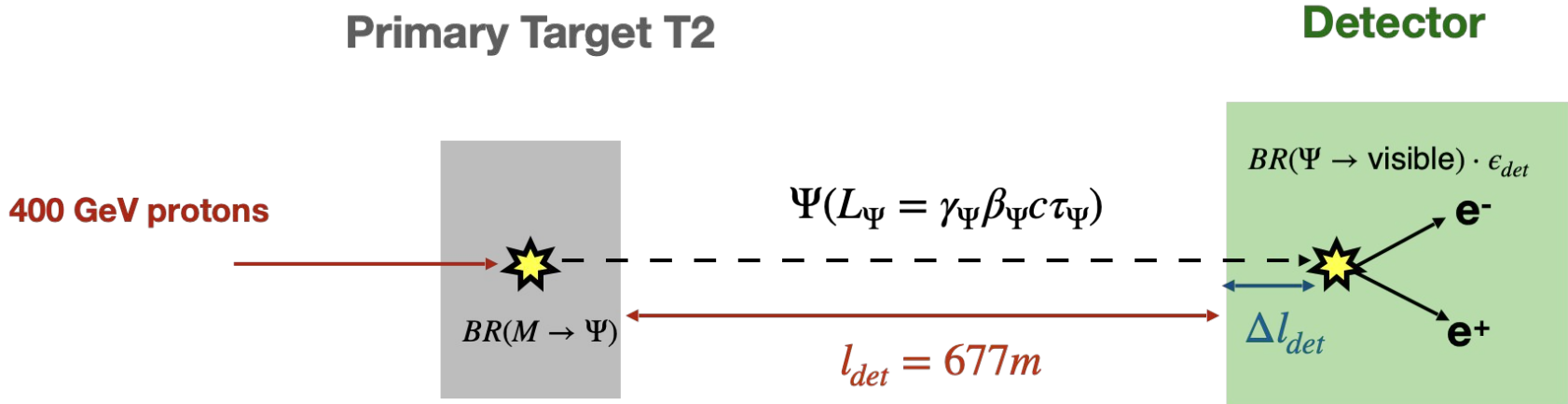
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Motivation

Both **ProtoDUNEs**, based on the LArTPC technology, are **ideal to search for weakly interacting particles in Beyond the Standard Model (BSM) scenarios**.

Their location at the Neutrino Platform may entail an exposure to a flux of such particles, produced in the collisions of 400 GeV protons extracted from the Super Proton Synchrotron (SPS) accelerator on a Be target. Nevertheless, **there is no trigger oriented to these events**.



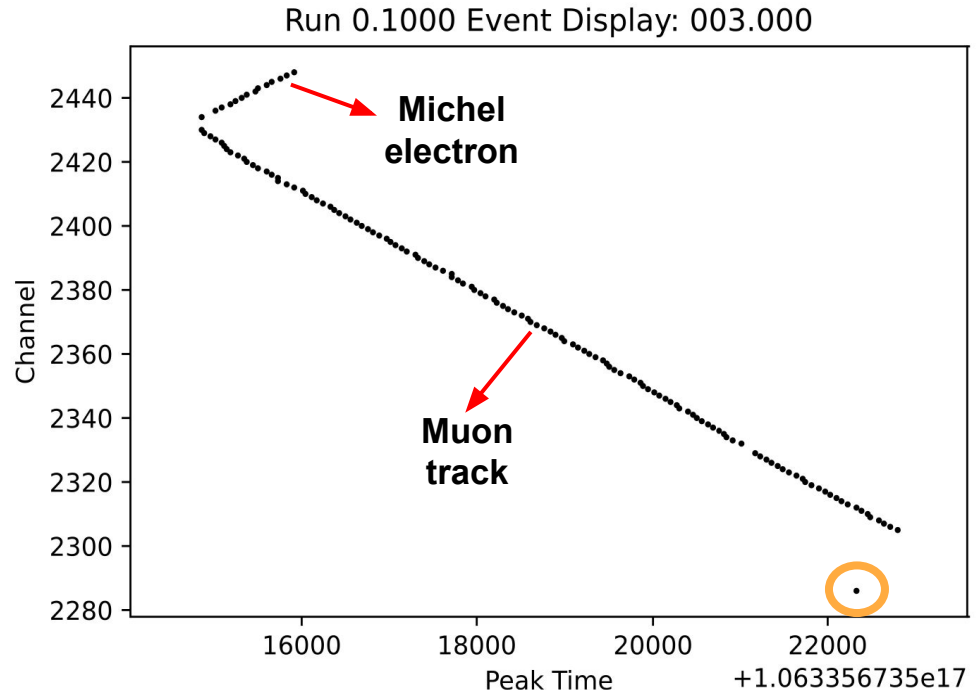
Goal

Currently my work is focus on developing a *Trigger Activity* (TA) algorithm to select muons to test the trigger algorithm:

- We are using *Trigger Primitives* (TPs) emulated data (simulations) from the VD Coldbox to test the algorithm.
- Currently, there is a very basic algorithm. We need to implement angular cuts, fiducial volume.
- First step: check the overall muon efficiency.

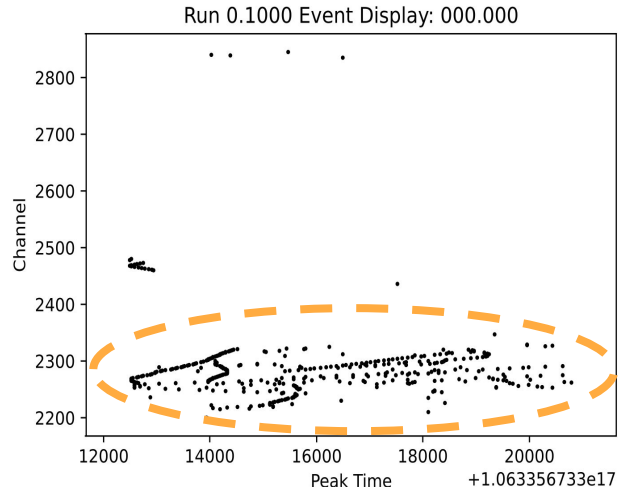
Trigger Activity Maker: *Horizontal Muons*

- Monitor the total number of collection channels with a hit of incoming TPs in a given time window (window length). Trigger if that total goes above some threshold value.
- Reconstruction performed at the collection plane.
- Y-axis: channel number with hits.
- X-axis: peak time given by electron drift.
- Example of a trigger selected event. As it is visible, some background is reconstructed as well.

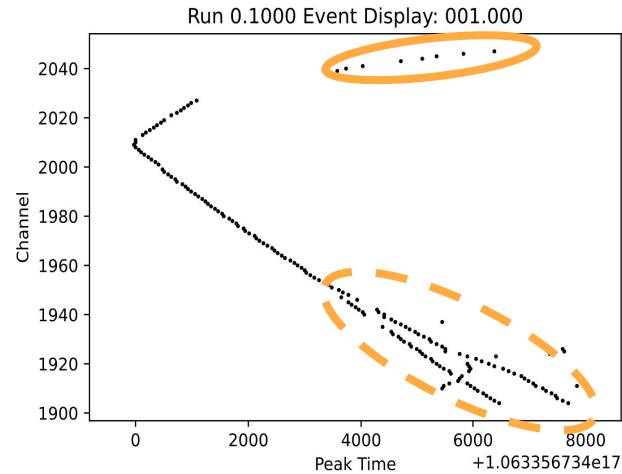


Trigger Activity Maker: Issues to be addressed

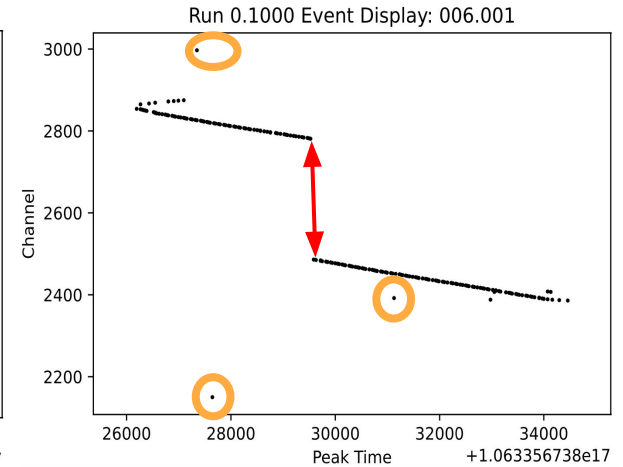
No Muon event



Noise and background



Track split



Most selected muons are stopping muons. Reason under study.

Next steps

- As a first step we need to complete and test the *horizontal muons TA algorithm* as a proof-of-principle. We may improve it by:
 - Debugging code.
 - Varying the threshold to remove noise and background.
 - Adding angular cuts, directionality and defining a fiducial volume.
 - For every kind of BSM scenario we need to identify signal and background to develop the trigger algorithm for those events.

Backup

Backup

Develop an online trigger software for BSM searches in ProtoDUNE using the DUNE trigger algorithms (useful developments to other DUNE and ProtoDUNE searches).

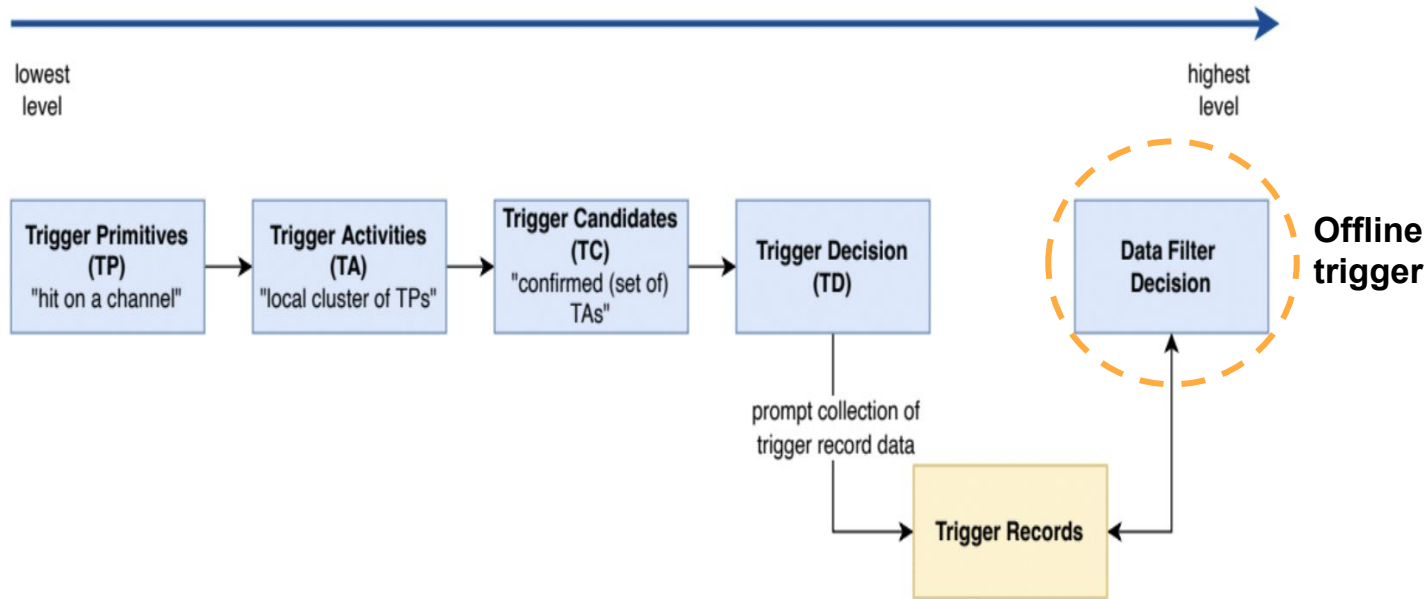


Figure 2.4: The flow of trigger objects in the TDAQ system.

Backup

```
// Configurable parameters.
bool m_trigger_on_adc = false;
bool m_trigger_on_n_channels = false;
bool m_trigger_on_adjacency = true; // Default use of the horizontal muon triggering
bool m_trigger_on_tot = false;
uint16_t m_tot_threshold = 5000; // Time over threshold - threshold to exceed.
bool m_print_tp_info = false; // Prints out some information on every TP received
uint16_t m_adjacency_threshold = 15; // Default is 15 wire track for testing
int m_max_adjacency = 0; // The maximum adjacency seen so far in any window
uint32_t m_adc_threshold = 3000000; // Not currently triggering on this
uint16_t m_n_channels_threshold = 400; // Set this to ~80 for frames.bin, ~150-300 for tps_
uint16_t m_adj_tolerance = 3; // Adjacency tolerance - default is 3 from coldbox t
int index = 0;
uint16_t ta_adc = 0;
uint16_t ta_channels = 0;
timestamp_t m_window_length = 8000; // Shouldn't exceed the max drift which is ~9375 62.
uint16_t ta_count = 0; // Use for prescaling
uint16_t m_prescale = 1; // Prescale value, default is one, trigger every TA
```

Backup

