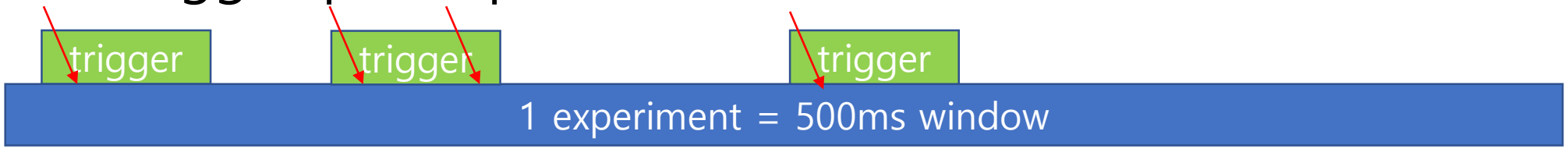
Trigger selection

- 100k experiments(500ms window) are performed with changed geometry and all generated CRY.
- Fake pulses for a bar are considered.
- Simulate FADC and TCB.
- It seems to work properly.

- Trigger threshold ~ 3 MeV
- Single track trigger (224ns window)
- # of trigger per experiment ~ 300



Trigger selection

- To select annihilation induced trigger, 3 variables are considered.
- dt cut, # of hits cut and offline threshold cut

- **Algorithm 1 :** use # of hits cut, threshold cut, and the dt between the fastest hits in T-B(L-R) bar sets.

- **Algorithm 2 :** use # of hits cut, threshold cut, and the dt between the all hits in T-B(L-R) bar sets.

Trigger selection

- Quantification
- **Selection efficiency :**

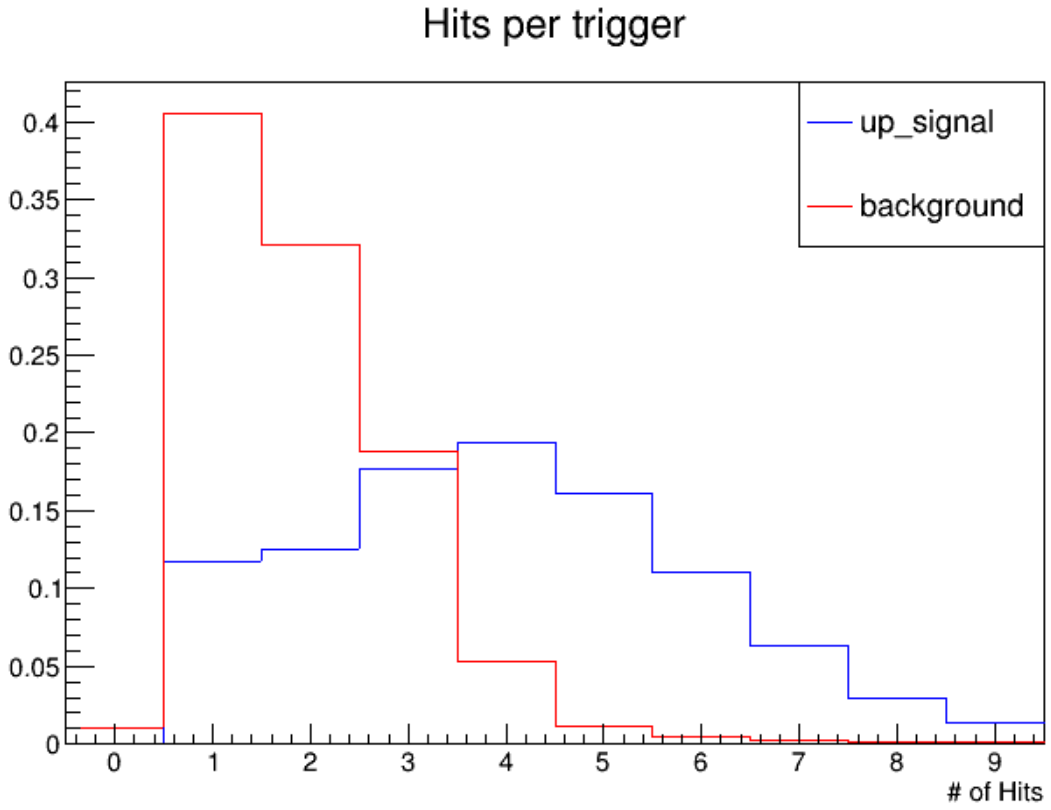
  # of experiments with only one trigger selected

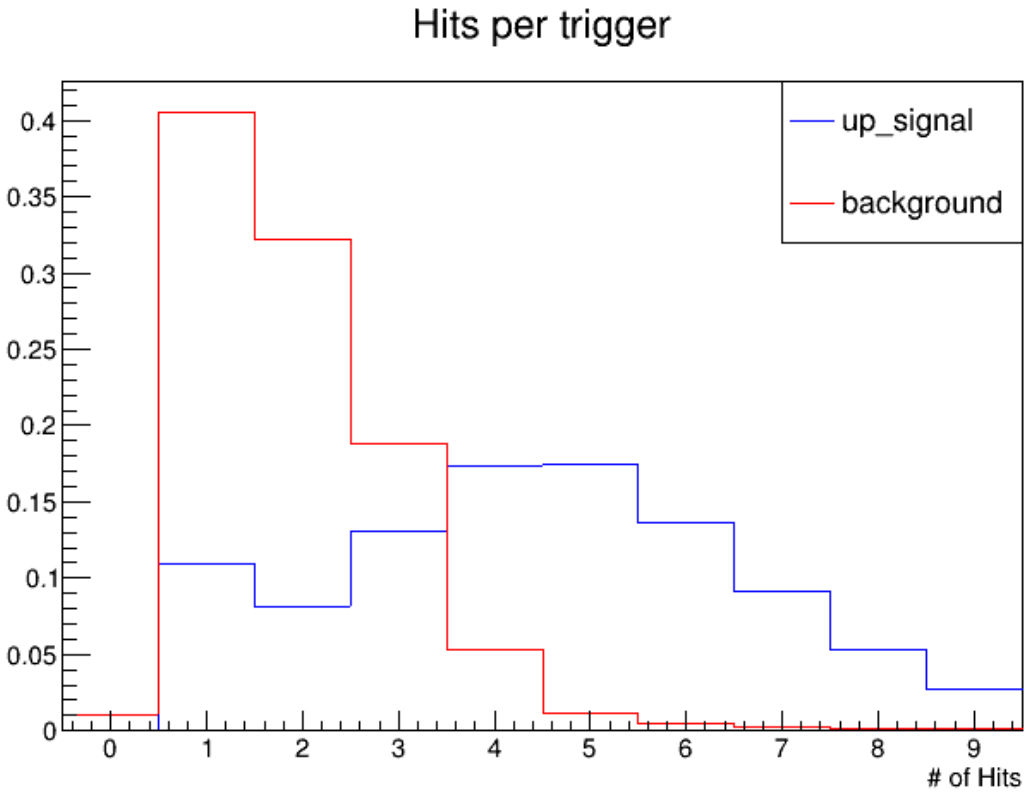
  /# of experiments
- **Selection accuracy :**

  # of experiments with the selected trigger is induced by pbar annihilation / # of experiments with only one trigger selected
- **Background rate** : 1 – (selection accuracy)
- **FOM(figure of merits)** : selection efficiency / background rate
- Errors are estimated with binomial distribution.

Trigger selection

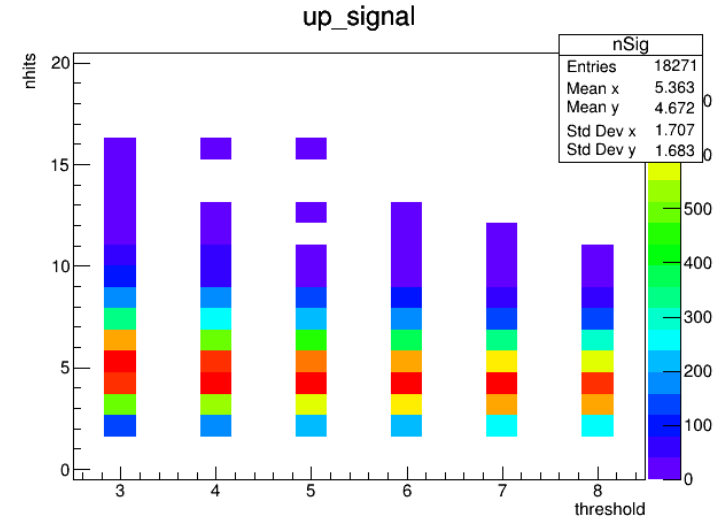
- # of hits distribution (offline threshold = 3MeV)

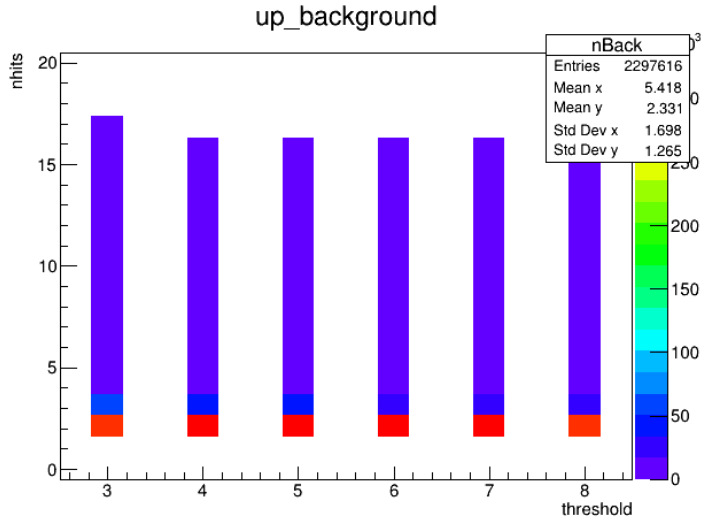


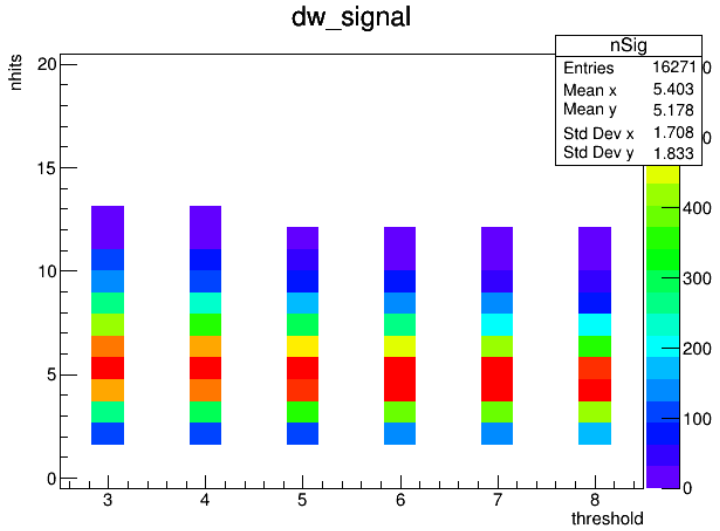


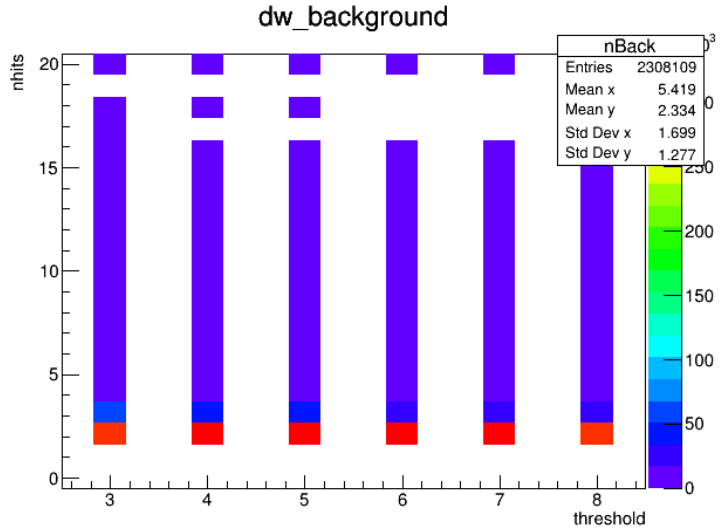
Trigger selection

- Offline threshold cut vs # of hits



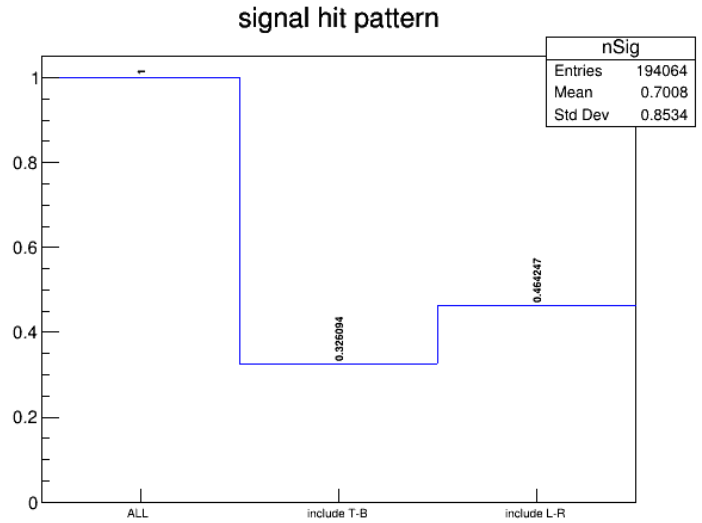


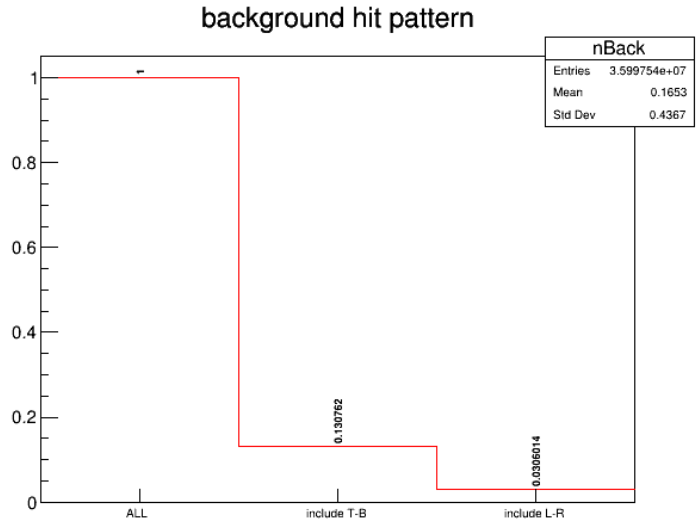


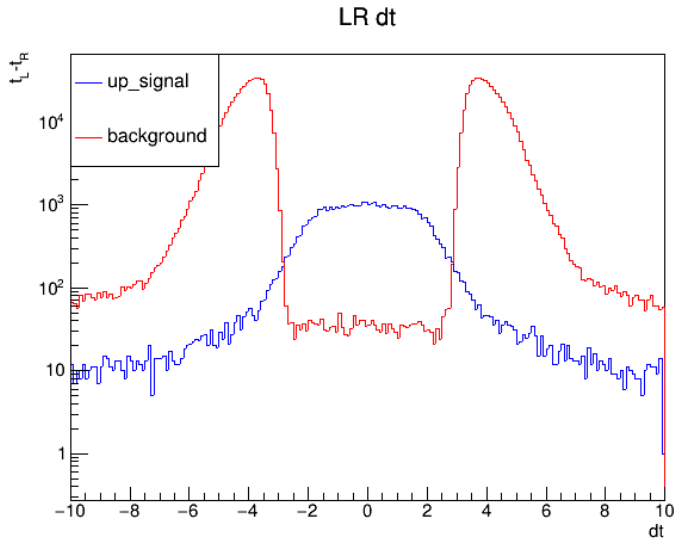


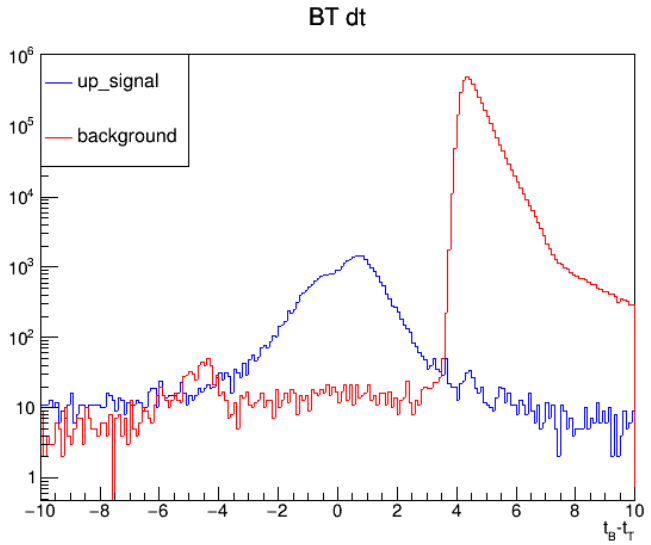
Trigger selection

- Hit pattern and dt



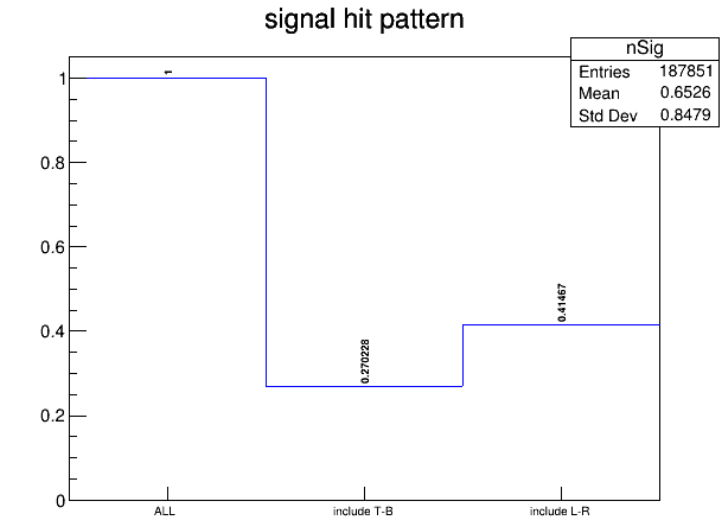


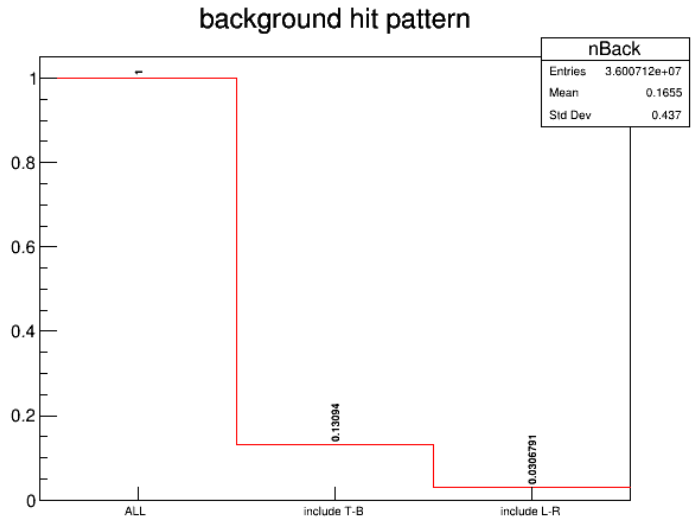


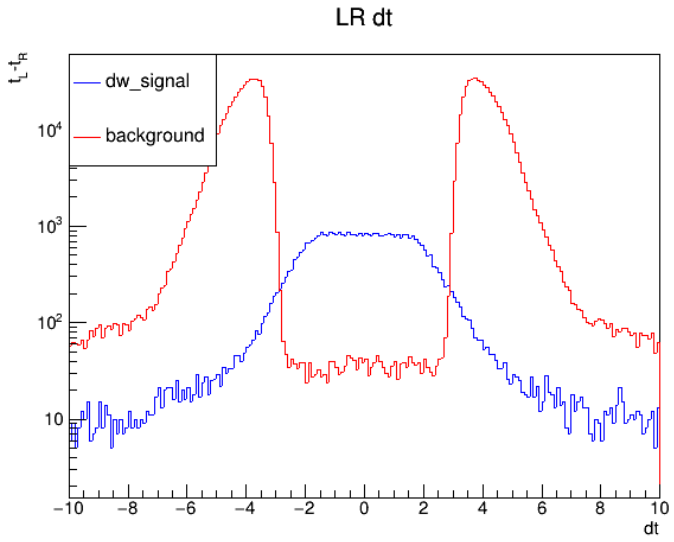


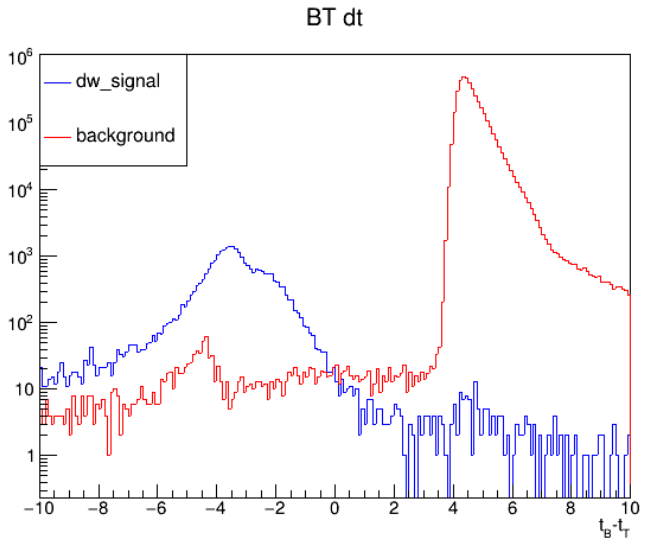
Trigger selection

- Hit pattern and dt









Trigger selection

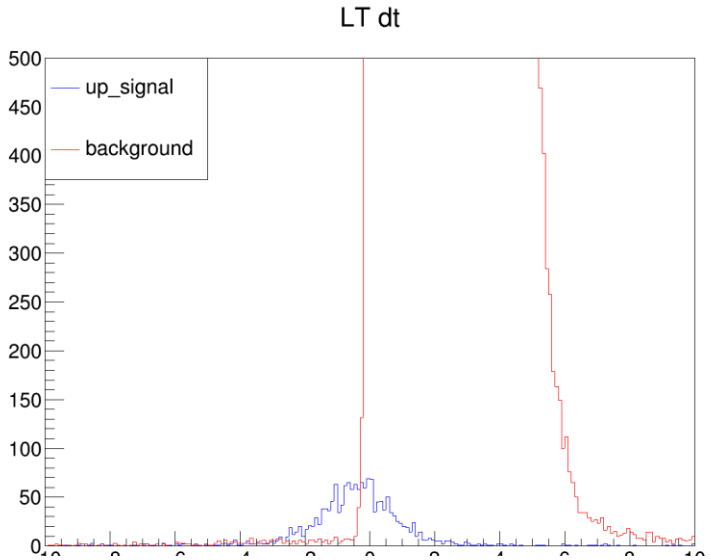
- $t_{fastest,B} - t_{fastest,T} < 2\,ns$, # of hits > 1 , energy loss > 5MeV cut
- $t_{fastest,L} - t_{fastest,R} < 2\,ns$, # of hits > 1 , energy loss > 5MeV cut

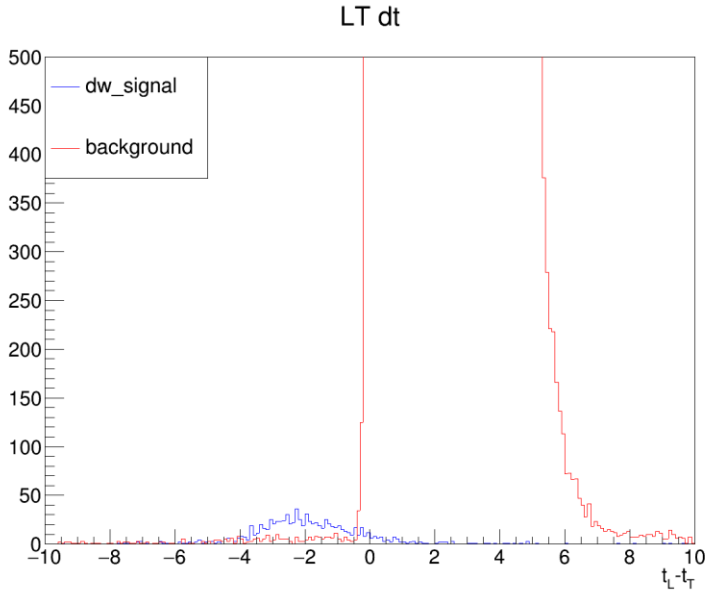
Gravity = down	Efficiency	Background rate
T-B	0.3023±0.0015	0.0478±0.001
L-R	0.3519±0.0015	0.0161±0.001

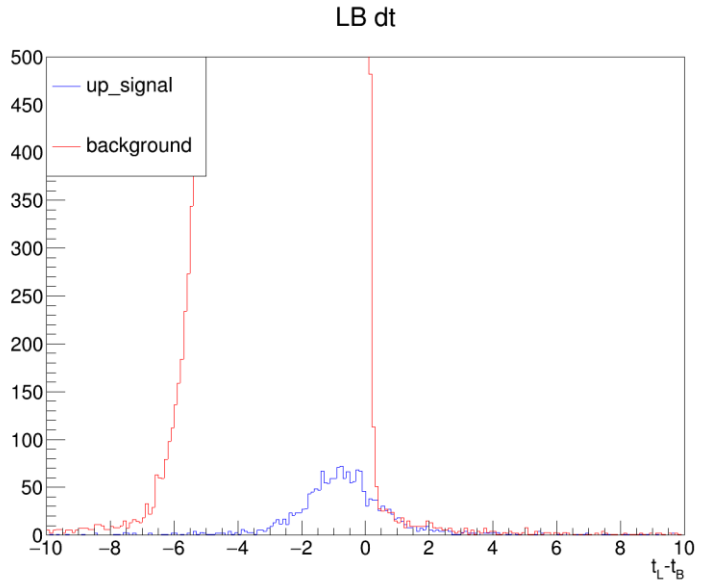
- Selection using L-R dt has good FOM, but we would be not able to specify direction of gravity. (there can be lack of T-B hits within a selected trigger.)

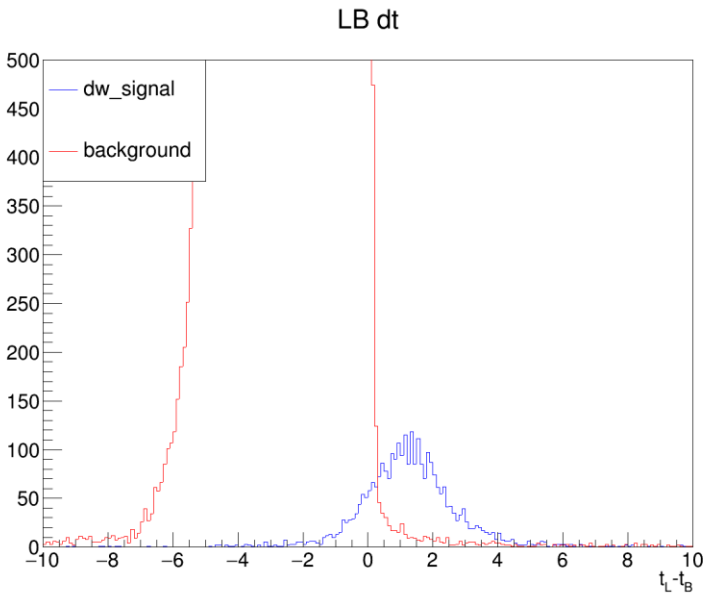
L-B, L-T dt distribution

- L-T (left), L-B (right)





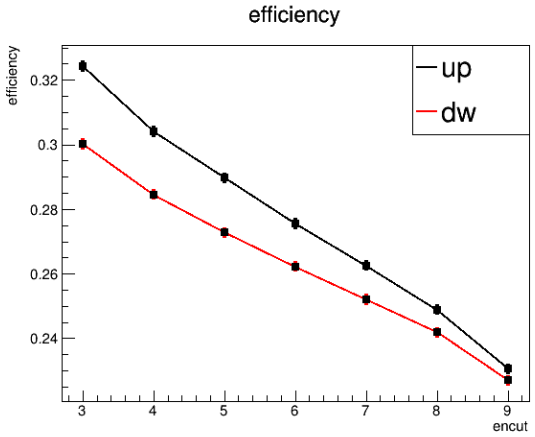


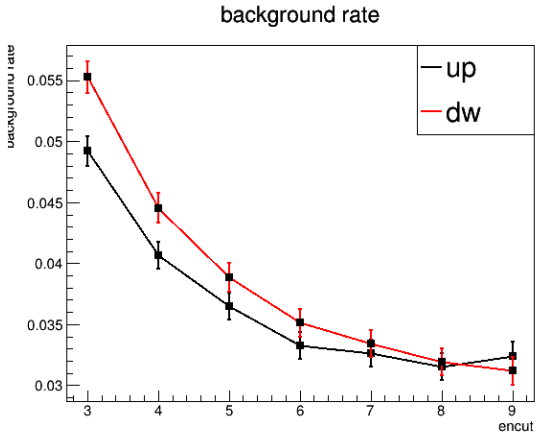


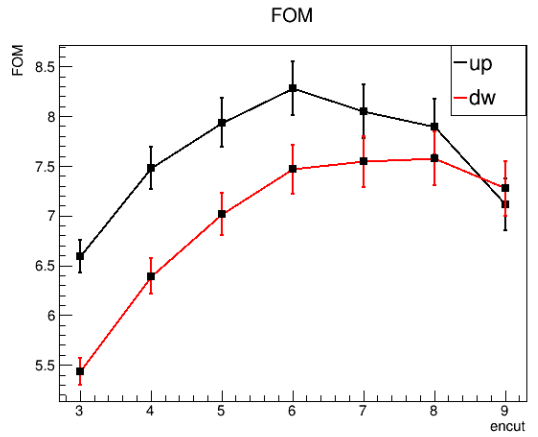
Trigger selection

- Algorithm1 is better at low threshold region.
- But its FOM is smaller than best FOM of algorithm 2.
- # of hits >2 and dt < 3ns cut

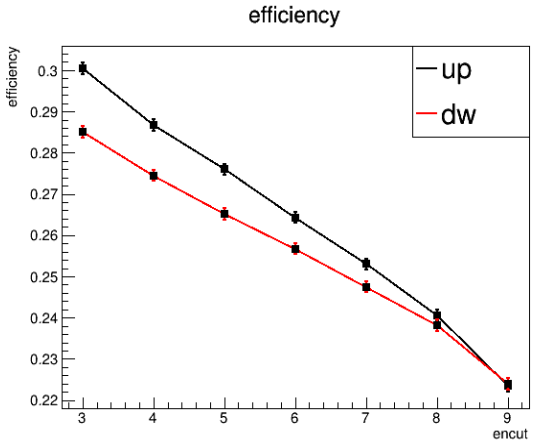
Algorithm1

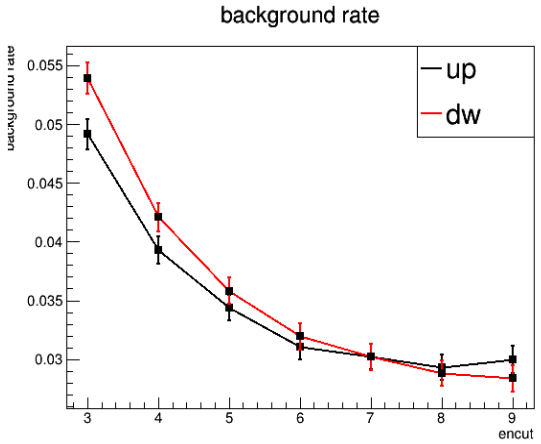


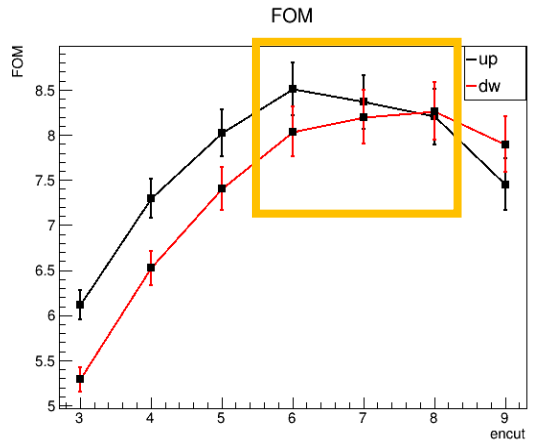




Algorithm2



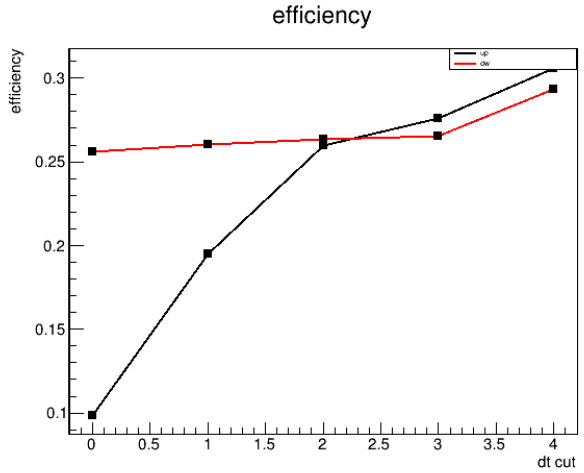


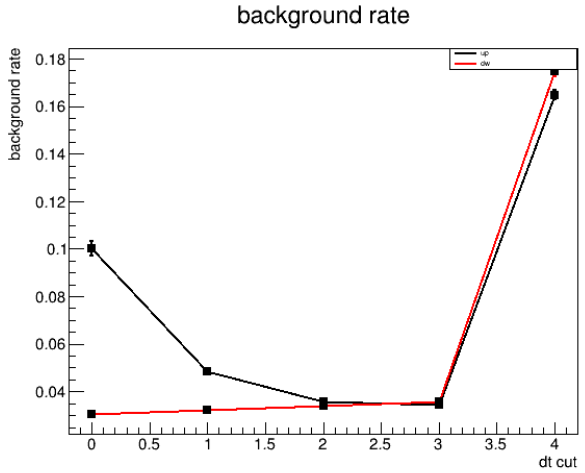


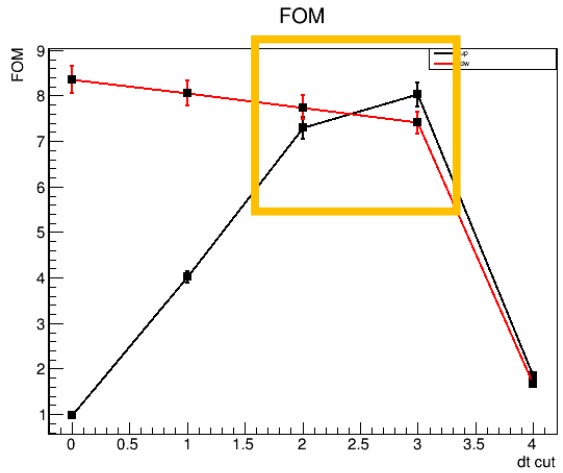
Trigger selection

- dt cut dependence (# of hits > 2)

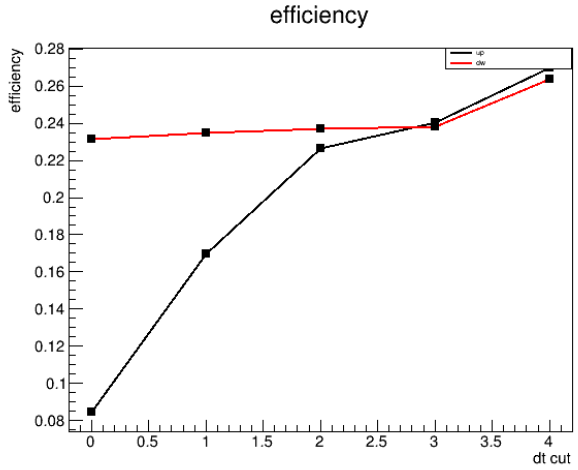
Threshold = 5MeV

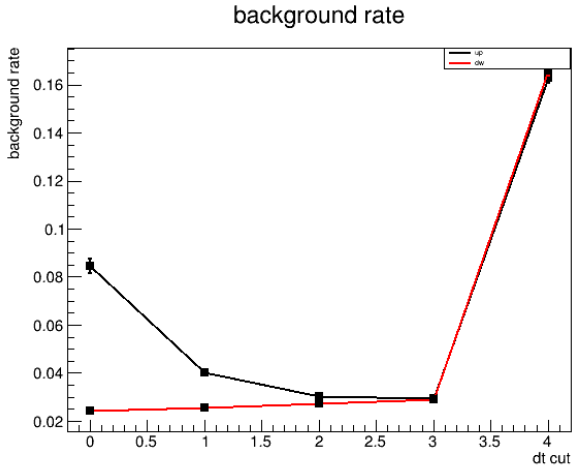


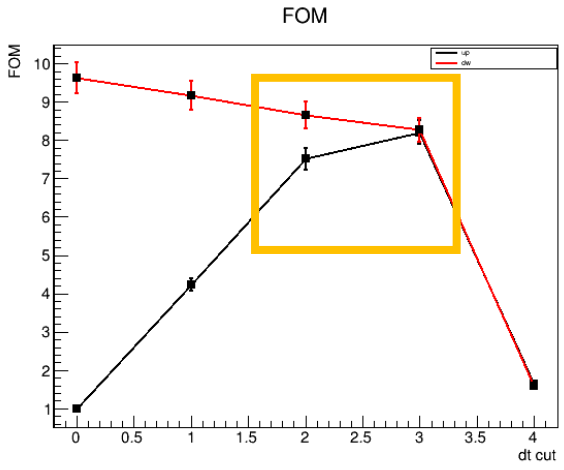




Threshold = 8MeV



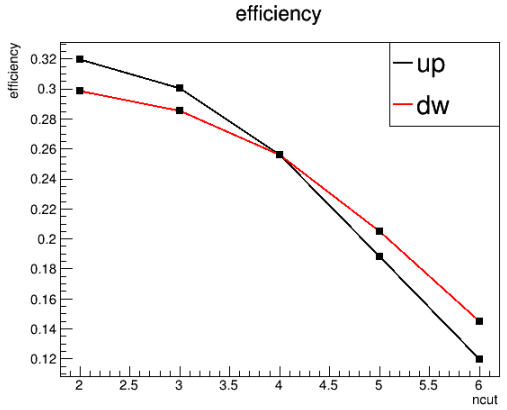


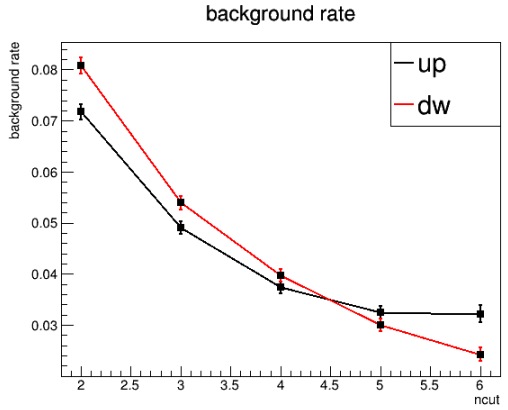


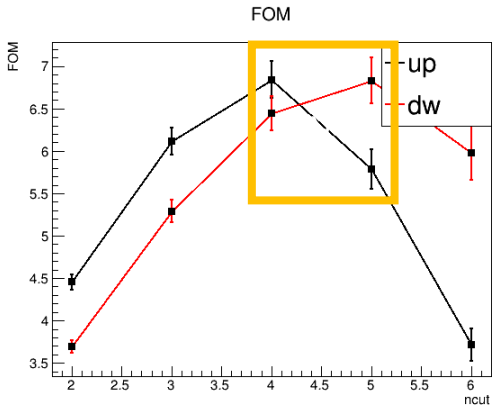
Trigger selection

• # of hits cut dependence (dt < 3 ns)

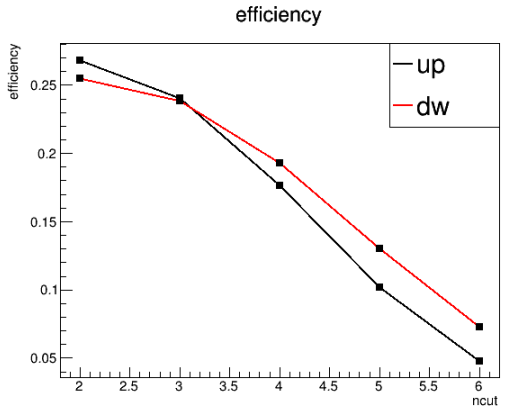
Threshold = 3 MeV

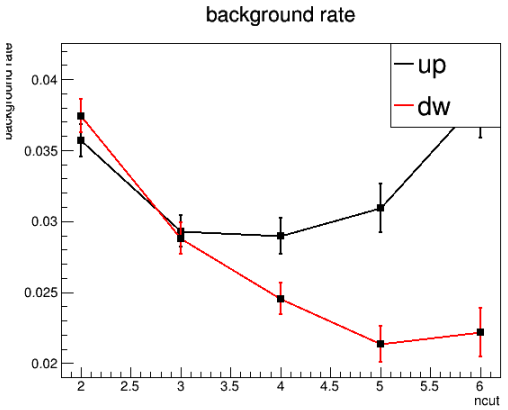


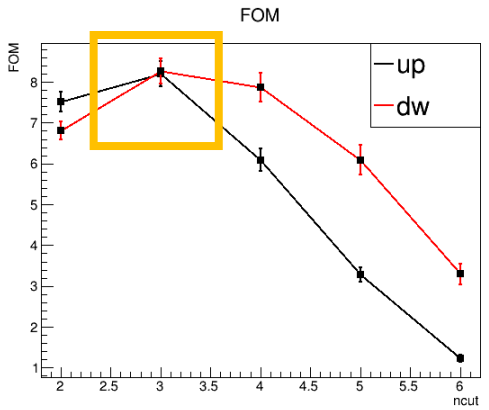




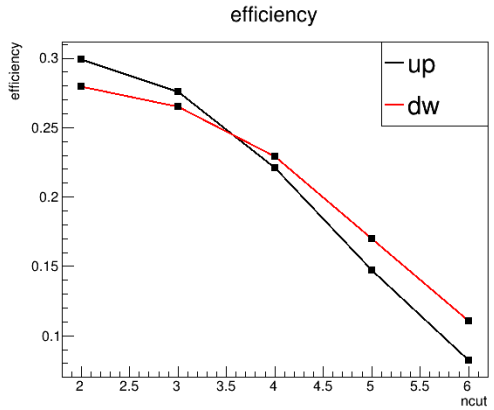
Threshold = 5 MeV

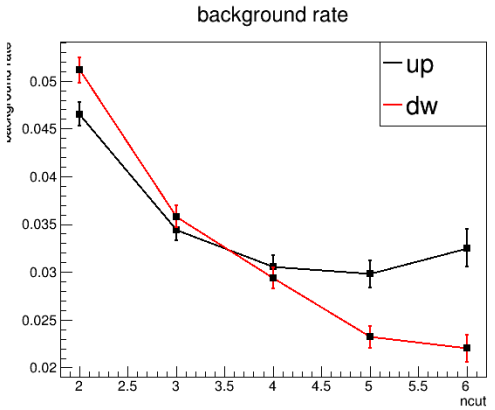


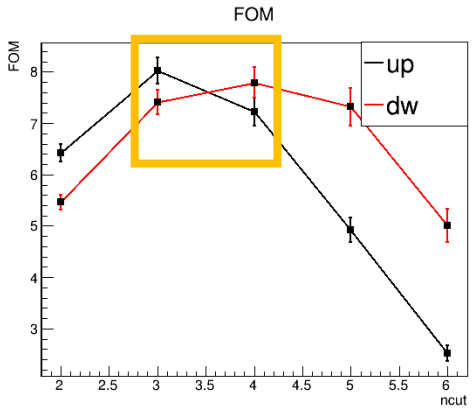




Threshold = 8 MeV







Trigger selection

- One best cut which can cover two extremal gravity :
  dt < 3 ns , # of hits > 2, threshold : 6~8 MeV

Threshold = 6 MeV

Gravity	Efficiency	Background rate	FOM
Upward	0.2643±0.0014	0.0311±0.0011	8.5098±0.2958
downward	0.2567±0.0014	0.0319±0.0011	8.0385±0.2796

Multi-Variable Analysis (MVA)?

- Machine running (NN, BDT, etc.)
- Cut for 3 variables -> Cut for 1 variable
- We do not know exact gravity for antimatter.
- Machine running with predetermined gravity will give bias to selection cut.

- Not good for now.