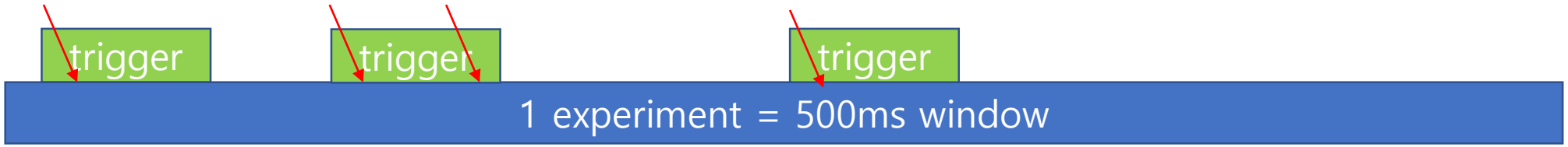
$\bar{g}$ determination

- In our previous meeting, The value of $\bar{g}$ is away from 9.81.
- The calculation of $\bar{g}$ was based on $z = 0.5gt^2$ since we do not know v_{0z} event by event.
- However, $z = v_{0z}t + 0.5gt^2$. time is correlated with v_{0z}. So we cannot average out such as $< v_{0z} >< t >= 0$.
- Instead, $< z/t^2 >=< v_{0z}/t > +0.5g$
- We can calculate z/t^2 exp. by exp. But v_0/t is not.
- So, we should know exact temperature, and determine $< v_{0z}/t >$ from MC. It might make statistical uncertainty higher.

Event selection

- 100k experiments(500ms window) and all generated CRY not only muon.

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



Previous event selection

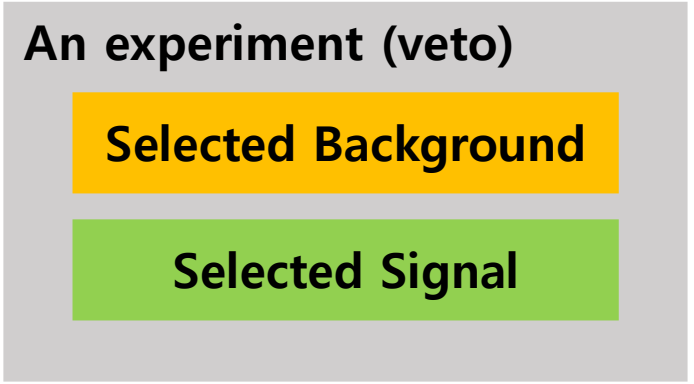
- Quantification
- **Selection efficiency :**

  # of experiments with only **one** event selected

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

  # of experiments with the selected event 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.

Event selection



- There were ambiguities in some definition.
- If above events occurs in an experiment window (it surely happens), we surely lose the signal.
- So, the quantification variables are better to rely on events, not experiments.

- Signal efficiency = S(selected signal events)/(total sig. events)
- Background rate = B/(S+B)
- Figure of merit = S/sqrt(S+B) or S/B
- Errors are treated as poisson error.

Figure of merit

- Some questions about defining fom.
- S/sqrt(S+B) is strongly depends on event numbers.
- S/B is almost independent about event numbers.

- For a given number of experiments, S/sqrt(S+B) is useful if we treat data statistically. (e.g see distribution of trigger time and find peak to calculate $\bar{g}$)
- If we treat data event by event, S/B is useful to reduce the background regardless the event numbers. (e.g trilateration?)

- **At least,** 5 sigma significance at selected signal # = 1000

-> corresponding background fraction = 0.975

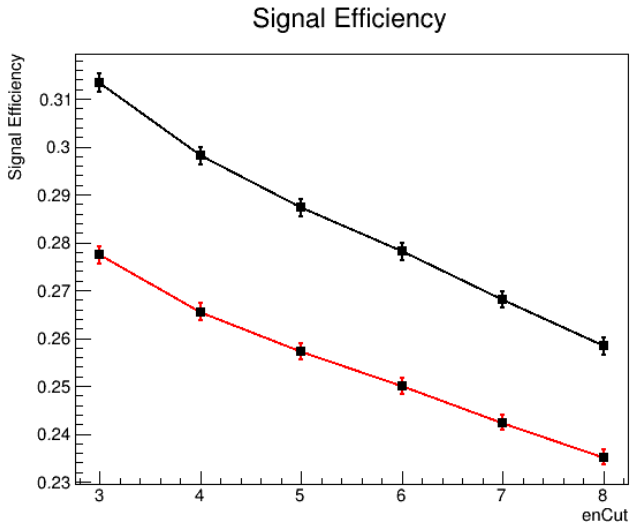
(with no cut background fraction = 0.9964)

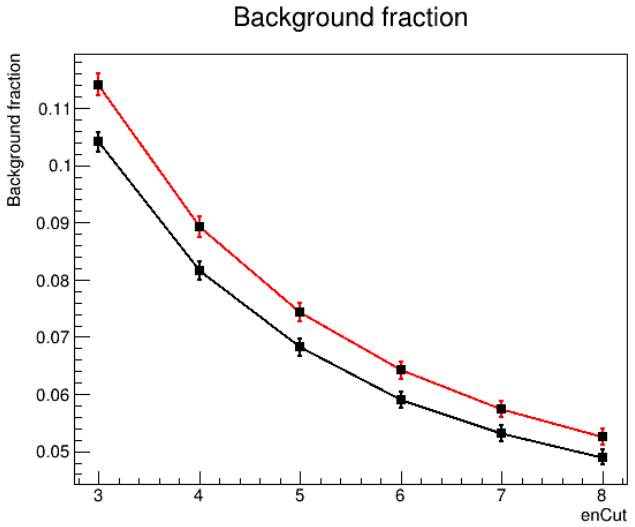
Need to decrease the background at least O(10)

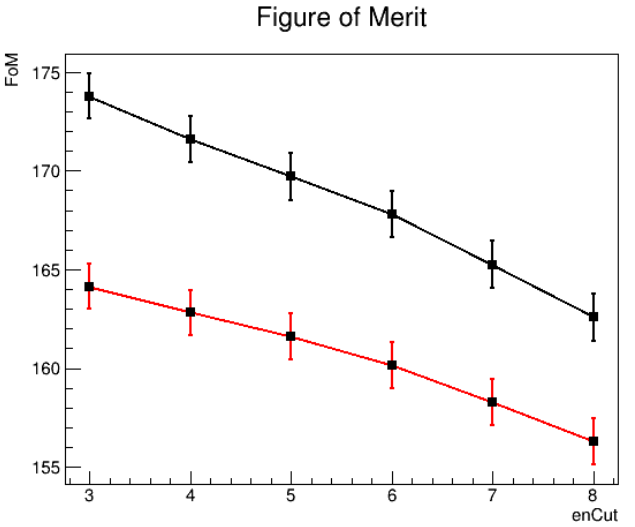
- # 1k comes from estimation of 1% g error.

Previous cut

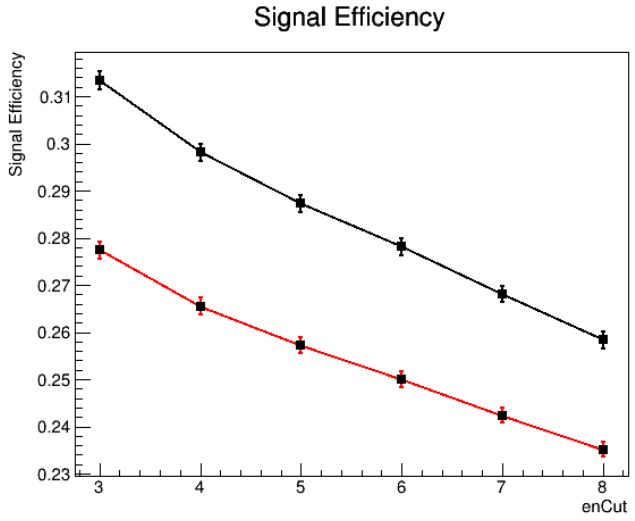
- S/sqrt(S+B) fom

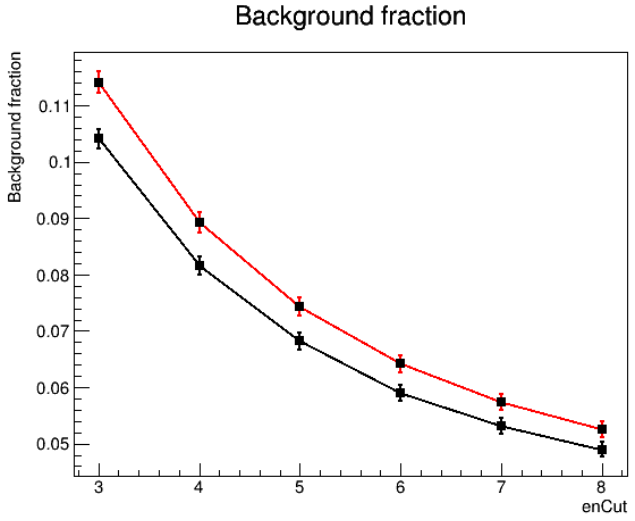


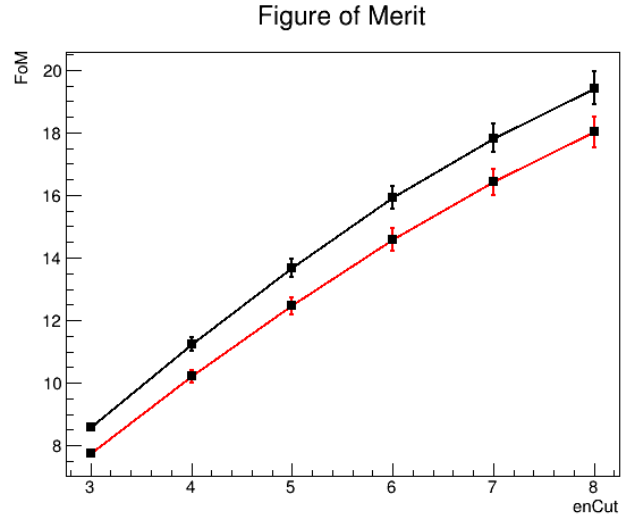




- S/B fom

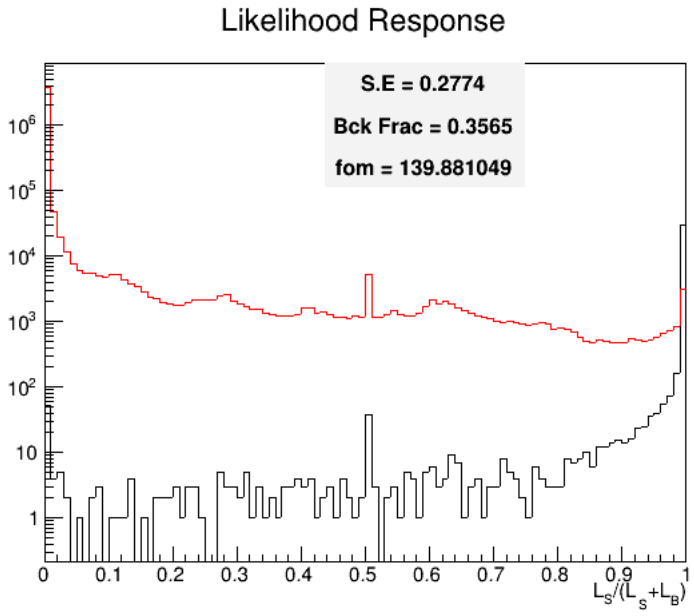


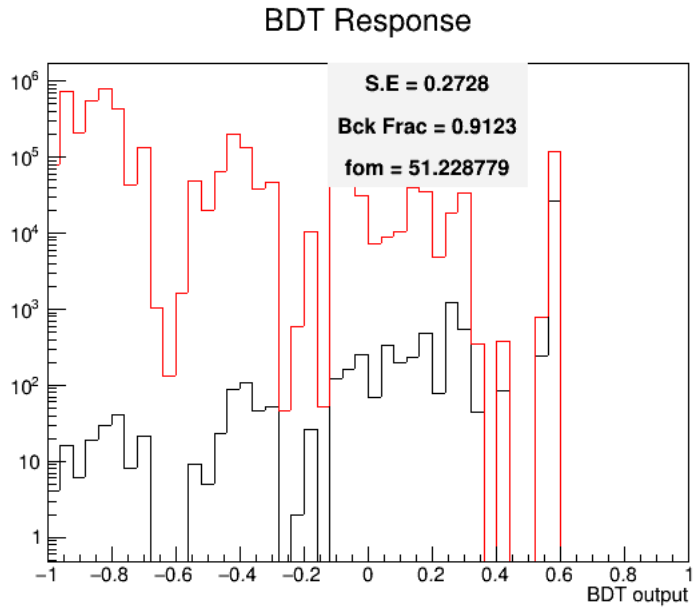




Likelihood and BDT response

- Use dt(TB), # of hits, total energy loss
- Downward gravity results



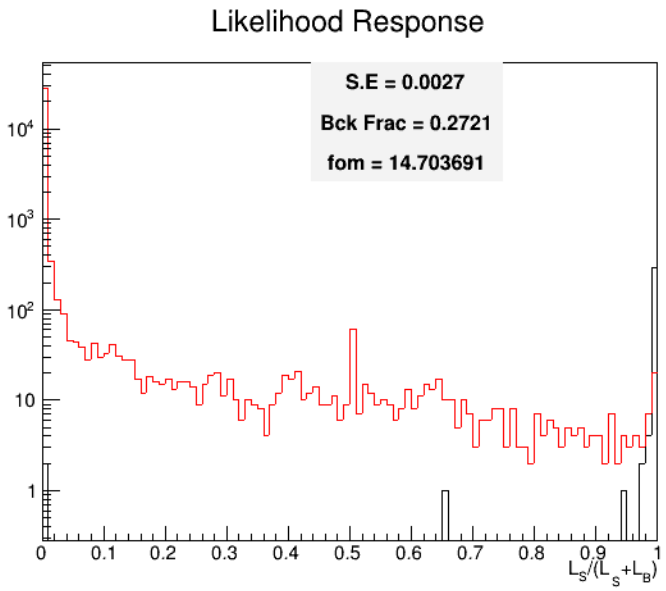


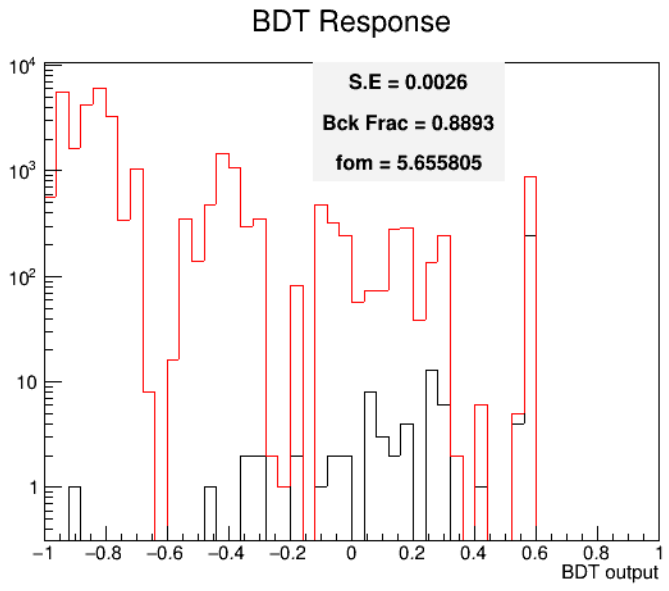
S.E = 0.2774
Bck Frac = 0.1141
fom = 164.136985

Previous cut
nHits>1
encut = 3MeV
dt<3

For small statistics

- 1000 annihilations
- Downward gravity results

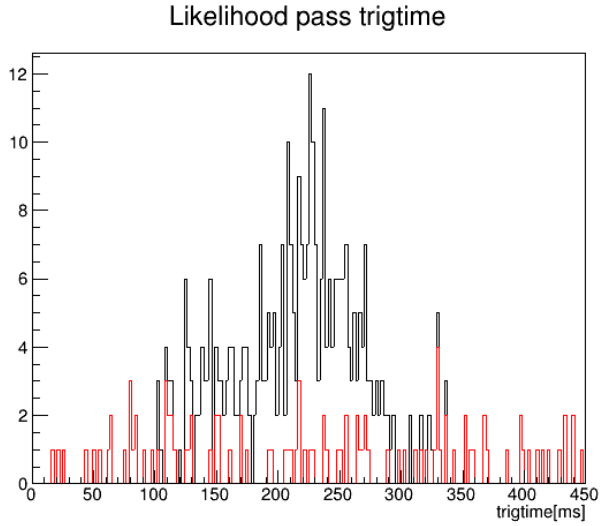


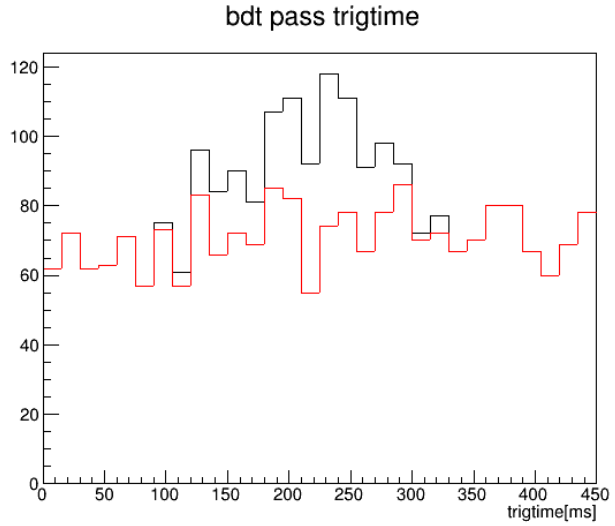


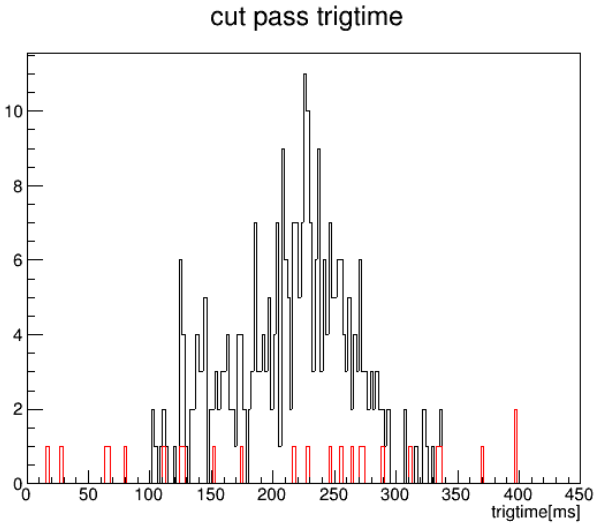
S.E = 0.0027
Bck Frac = 0.0776
fom = 16.551163

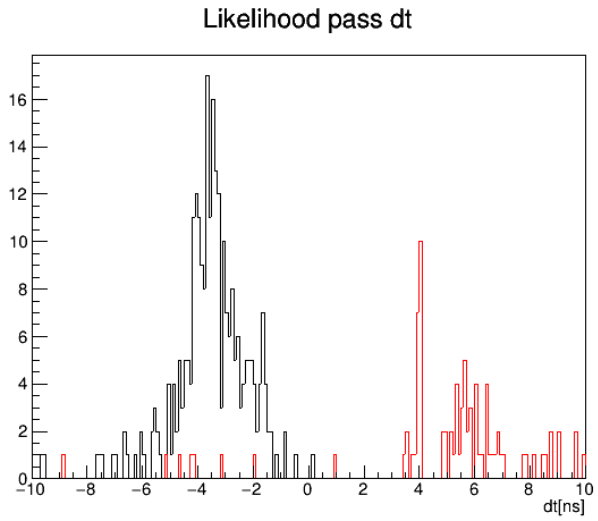
Previous cut
nHits>2
encut = 3MeV
dt<3

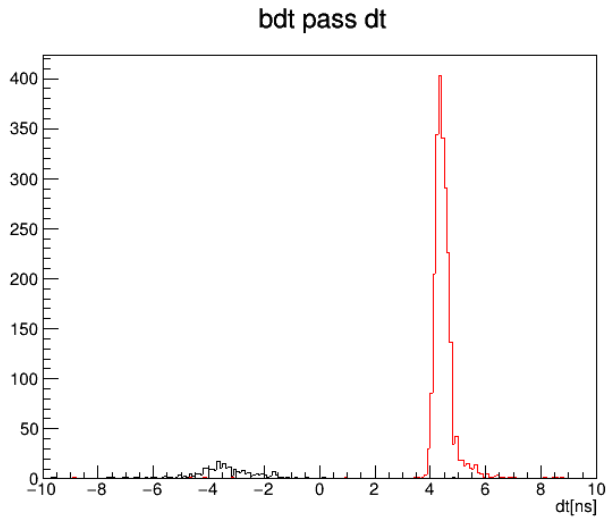
Distributions for 1k ann.

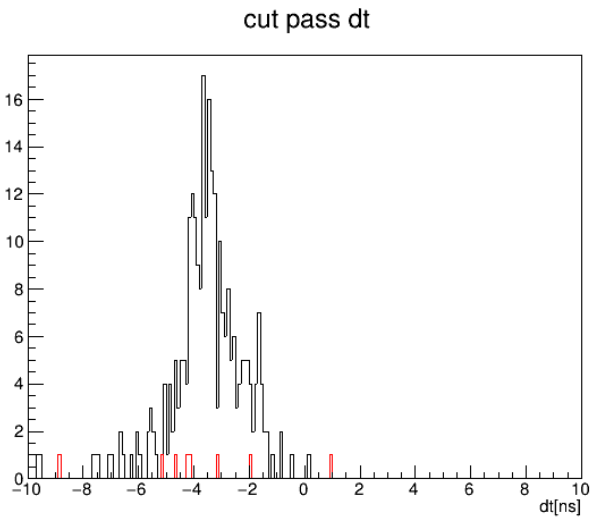












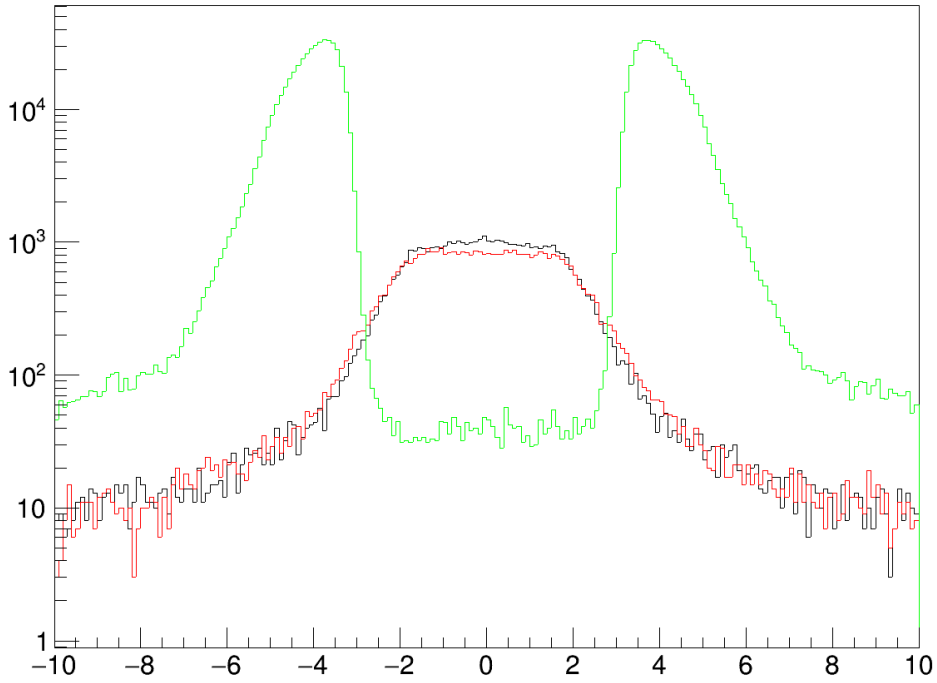
LR dt distribution

- To increase the signal efficiency, L-R combination is considered.

- No cut

-> up efficiency = 0.476

-> dw efficiency = 0.551



TB – LR combination

- Select events have TB combination or LR combination

- No cut on dt

-> up efficiency = 0.677

-> dw efficiency = 0.605

-> background fraction ~ 0.99

TB – LR combination

- Select events have TB combination or LR combination
- cut pass condition : dt_TB < 3 and abs(dt_LR) < 2.8

-> up efficiency = 0.616

-> dw efficiency = 0.551

-> up background fraction = 0.087

-> dw background fraction = 0.095

Machine learning goal

- At least 70% signal efficiency & At least 5 sigma significance at 1k selected signals

  -> 90% background should be rejected.

- Make better than hand cut

->At least 70% signal efficiency

->At least background fraction<10%

(Should reject 0.99975 of background)

->But # of Inputs should be same for every events.

->case by case machine learning? (separate cases such as TB or LR?)