stt Bhabha Background Study

B2GM TRG Parallel Session

2022-10-07

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Goal and Strategy

- There is large Bhabha background in stt. Thus we are going to study the Bhabha events in stt.

stt = typ + !bha_veto + !veto
typ = (N of Neuro 3D track with $p > 0.7$ GeV/c) > 0
bha_veto = ECL Bhabha veto signal
veto = KEKB Injection veto

- Finding the most efficient variable to suppress the Bhabha in stt is the goal of this study.

- To suppress the Bhabha in stt, 1-cluster veto and 2-cluster veto will be add to the stt in this presentation.

Bhabha MC simulation

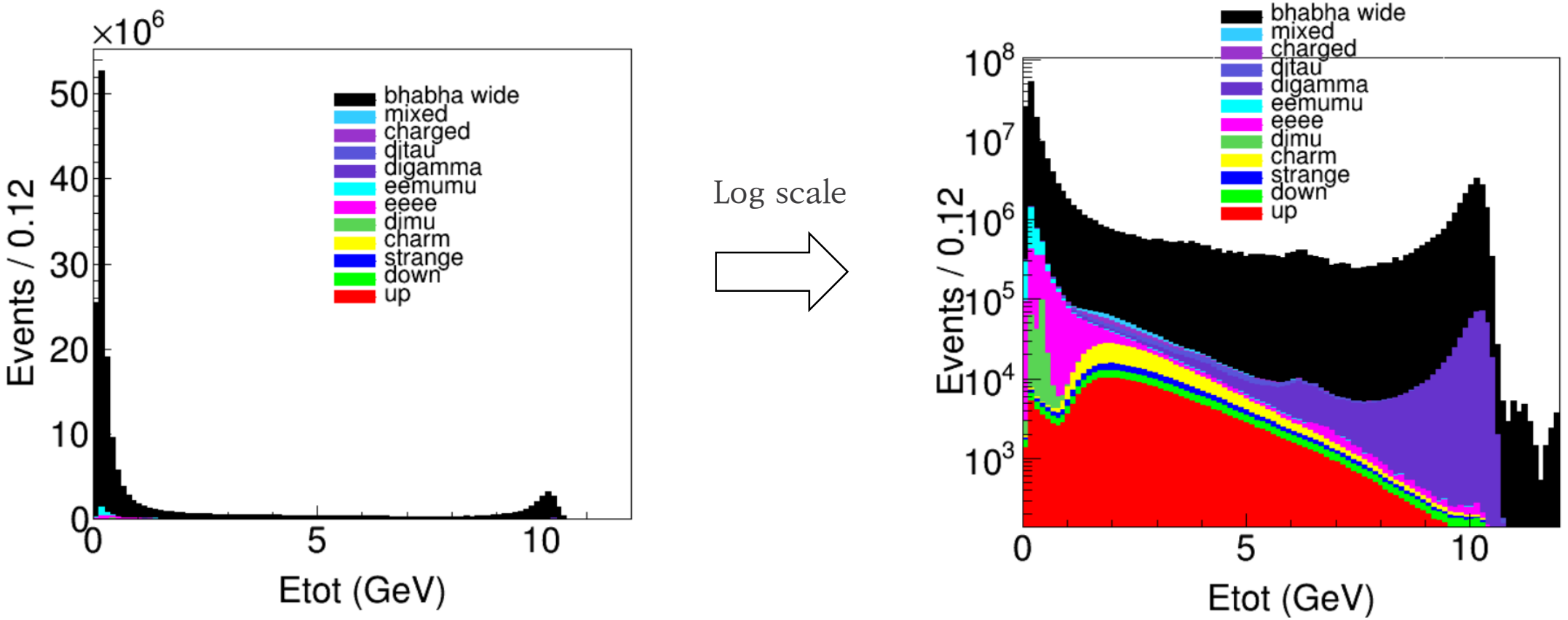
- generator for bhabha: BHWideInput
- Global tag: exp24, run740
- Cuts: scattering angle = [0.5, 179.5],
  both tracks are larger than 1 degree,
  one of them has an angle greater than 10 degrees
- Inst. Lum.$= 3 \times 10^{34}\ \mathrm{cm}^{-2}\mathrm{s}^{-1}$
- Bhabha Cross section $= 123\ \mu\mathrm{b}$
- Generated events = 100M

The other generated MC

Event Type	Generated Event	Cross Section (nb)
$B^{\pm}$	2M	0.571
B^{0}	2M	0.539
$u\bar{u}$	2M	1.61
$d\bar{d}$	2M	0.40
$s\bar{s}$	2M	0.38
$c\bar{c}$	2M	1.30
$\gamma\gamma$	2M	4.99
$\tau^{+}\tau^{-}$	2M	0.919
$\mu^{+}\mu^{-}$	0.2M	1.61
$\mu^{+}\mu^{-}e^{+}e^{-}$	2M	18.87
$e^{+}e^{-}e^{+}e^{-}$	2M	39.74

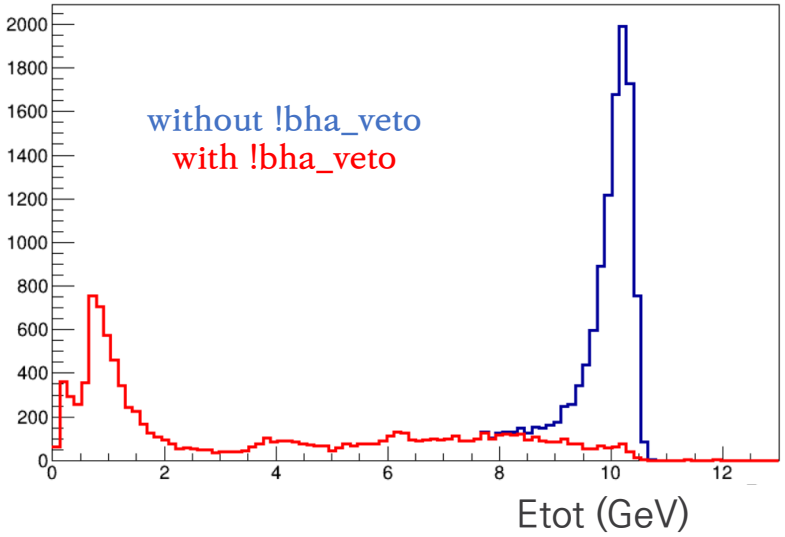
Inst. Lum.$= 3 \times 10^{34}\ \mathrm{cm}^{-2}\mathrm{s}^{-1}$

MC generation – before stt

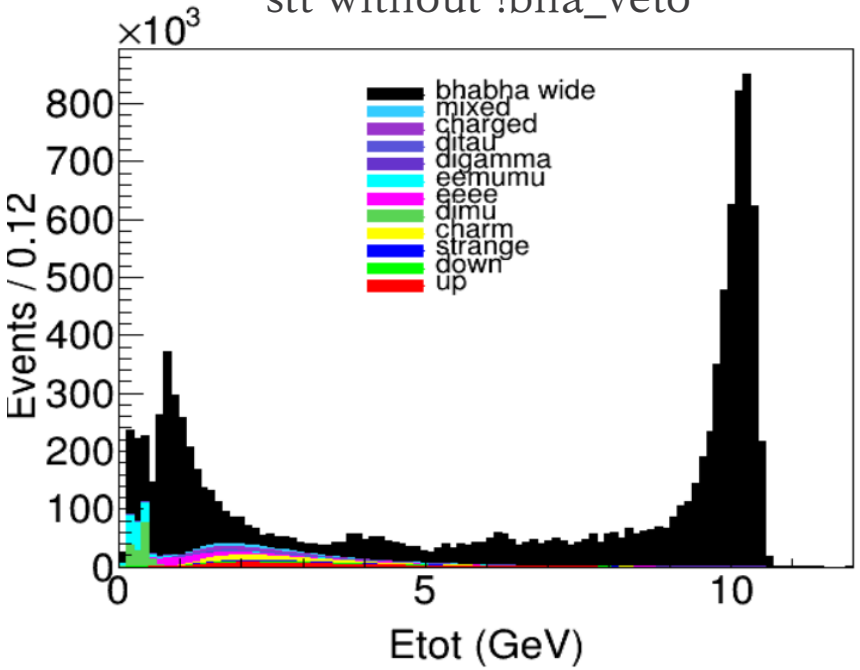


stt with/without !bha_veto

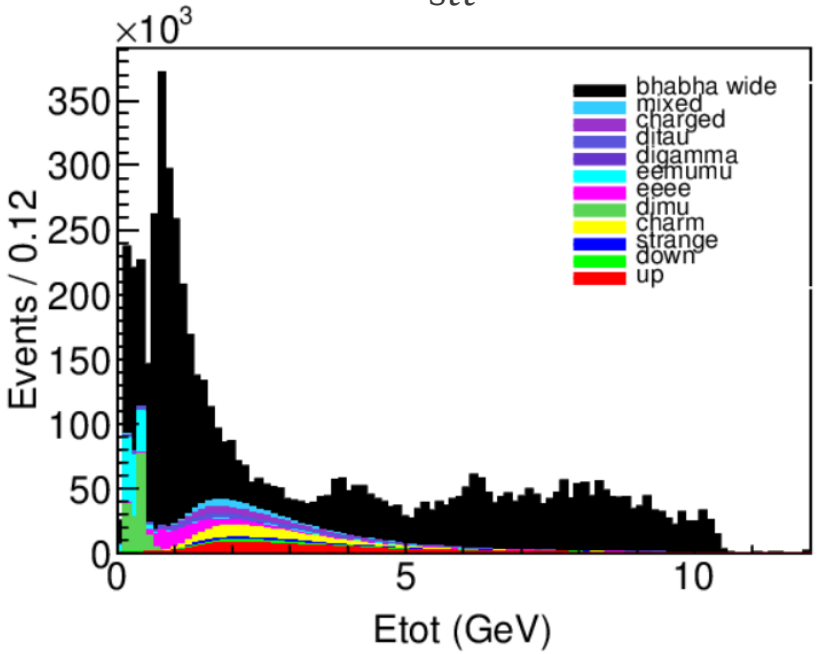
Bhabha event only



stt without !bha_veto



stt



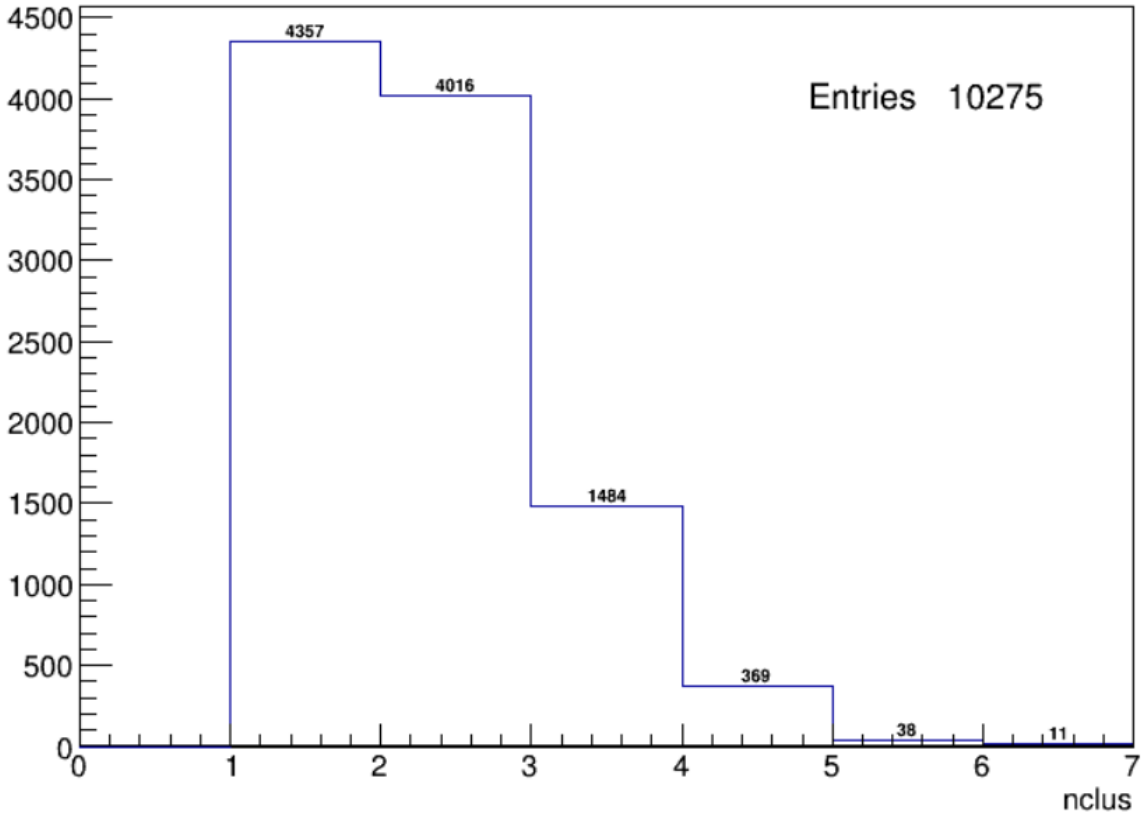
After the stt, there is still large Bhabha background left.

trg rates (Hz)	total	Bhabha	udsc	BB	$\mu^+\mu^-$	$e^+e^-e^+e^-$	$e^+e^-\mu^+\mu^-$	$\gamma\gamma$	$\tau^+\tau^-$
without !bha_veto	948	745	79	27	25	26	24	3.3	20
stt	580	379	78	27	25	26	24	1.3	20

TRG Cluster study

- To check the energy and angular distribution of the Bhabha event with stt, the TRG cluster is studied.

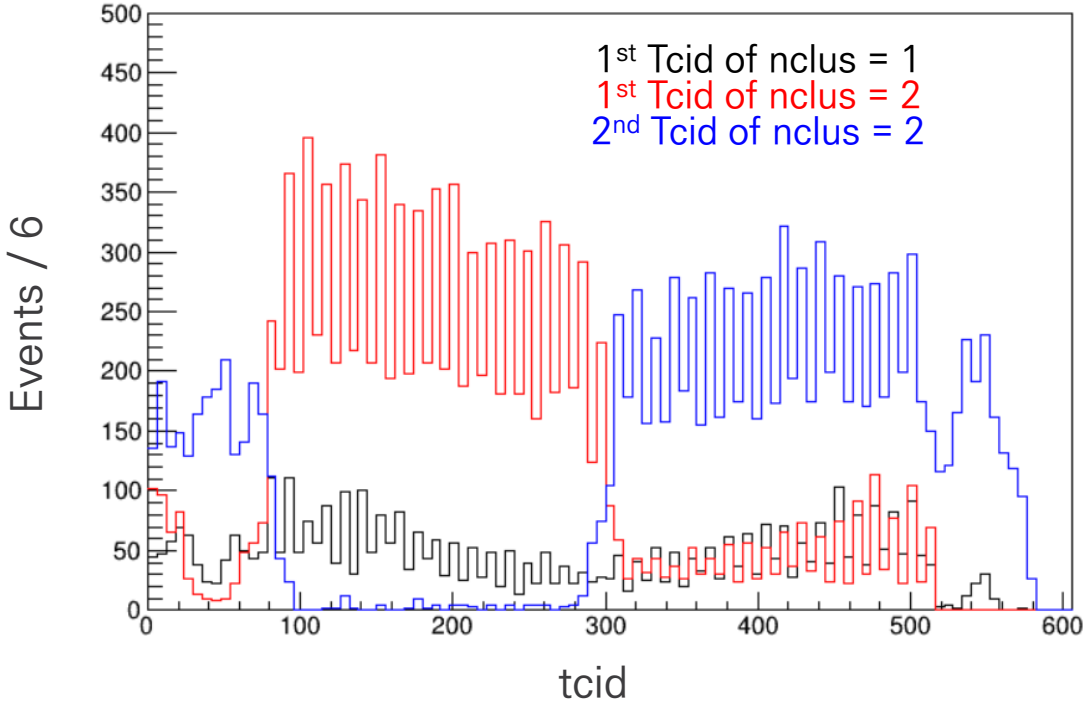
The number of clusters of Bhabha events in stt



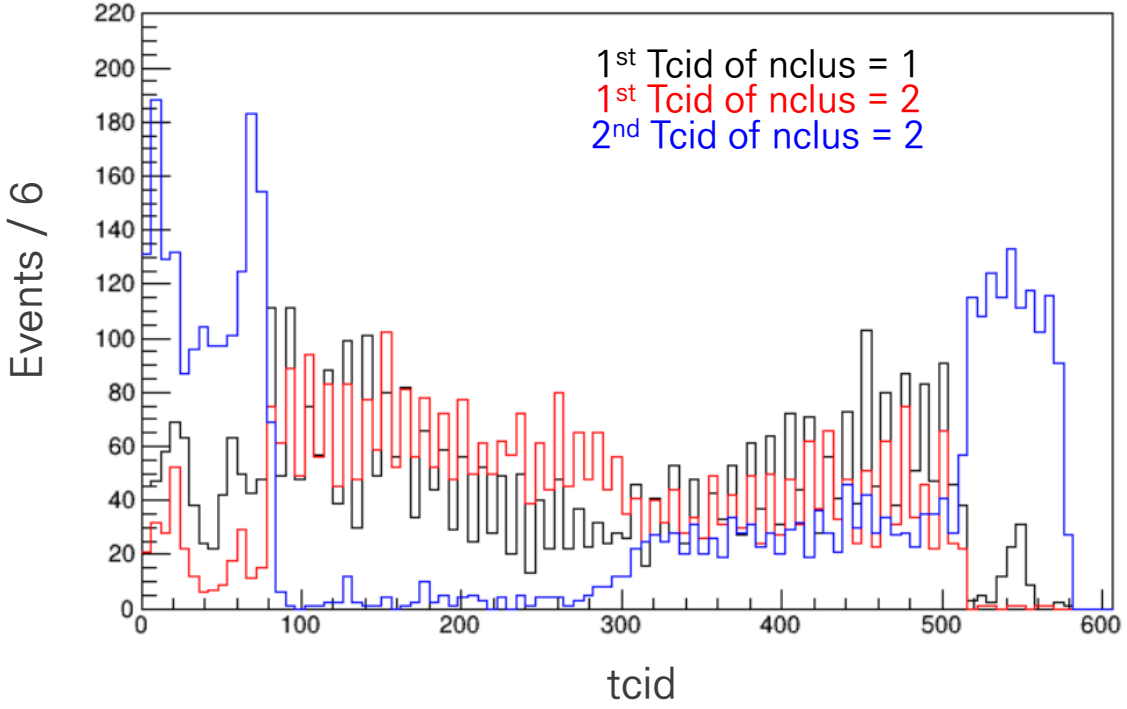
Tcid study for Bhabha events

- For the number of clusters =1 with stt, there are some events in the FW endcap.
- For the number of clusters =2 with stt, most second cluster events are on both endcaps.

stt witout !bha_veto



stt

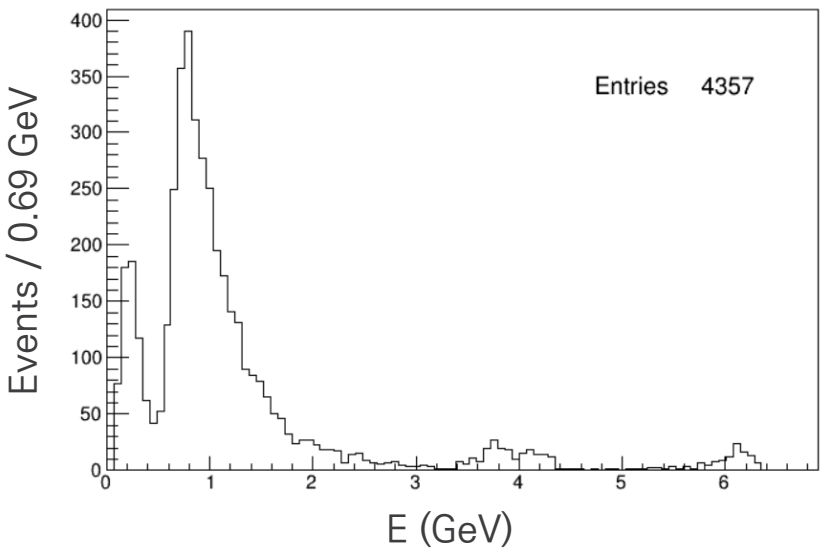


tcid< 80 : FW endcap
80 <tcid< 500 : Barrel
tcid> 500 : BW endcap

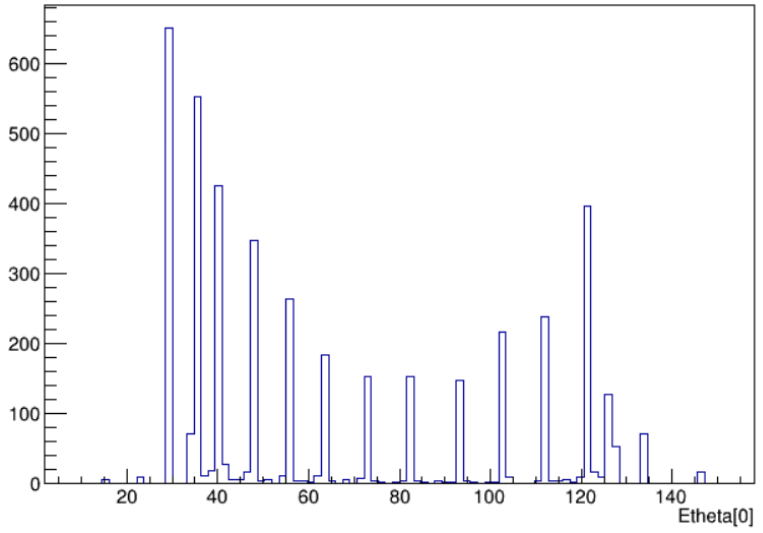
The number of clusters = 1 with stt

- The energy distribution of the cluster in case of N_{clus}=1 is concentrated on the lower side.
- The θ vs E distribution shows that some of clusters of the low energy are on the FW endcaps
- 1−cluster veto ≡ !(ncluster = 1 && ($\mathrm{tcid}_{1\mathrm{nd}} \leq 80$)) can be applied to suppress the Bhabha.

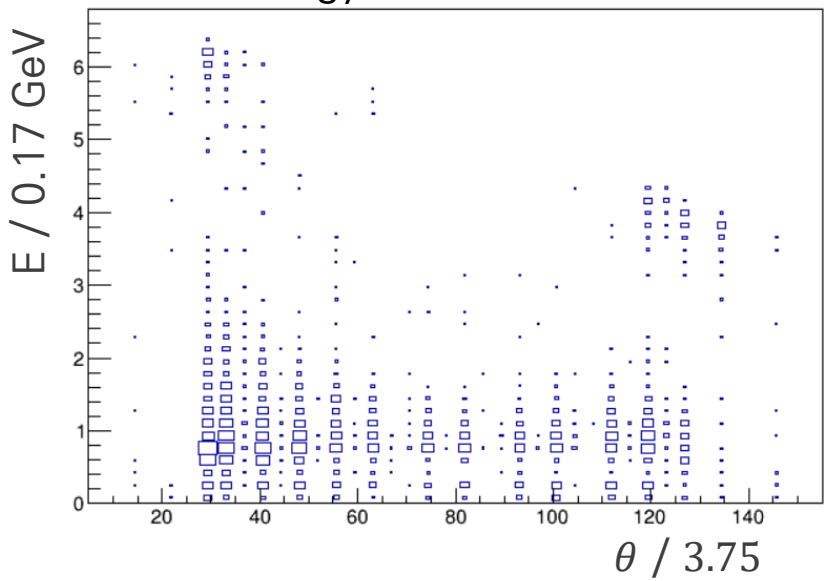
Energy of ncluster =1



θ of ncluster =1



Energy vs θ of ncluster =1

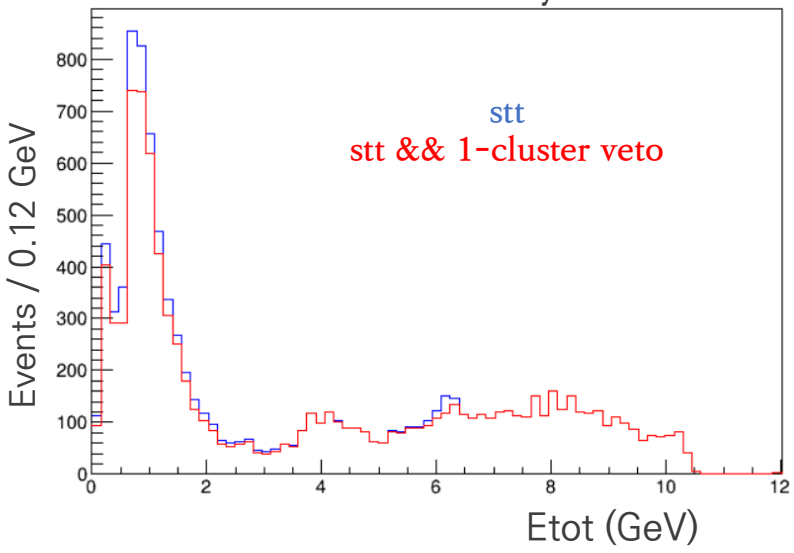


- Because CDC doesn't cover the endcap, the 1−cluster veto doesn't have much effect.

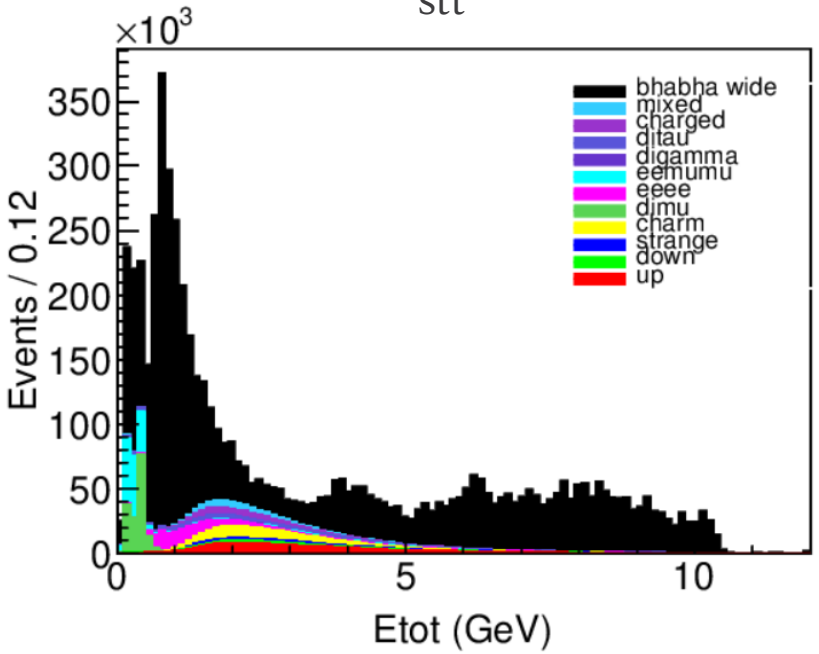
The number of clusters = 1 with stt

- stt && 1−cluster veto ≡ !(ncluster = 1 && ($tcid_{1nd} \leq 80$))

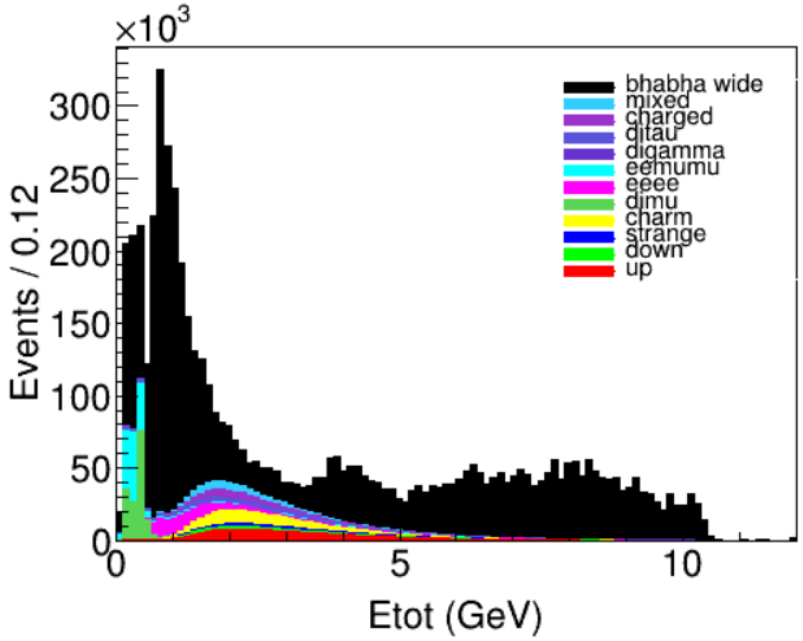
Bhabha event only



stt



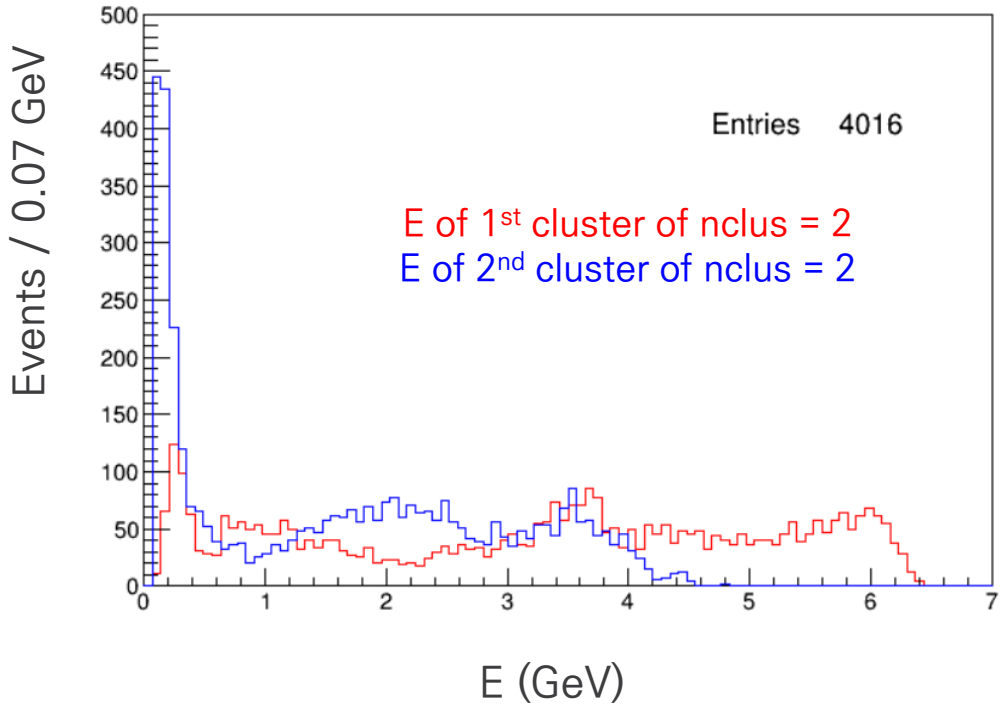
stt && 1-cluster veto



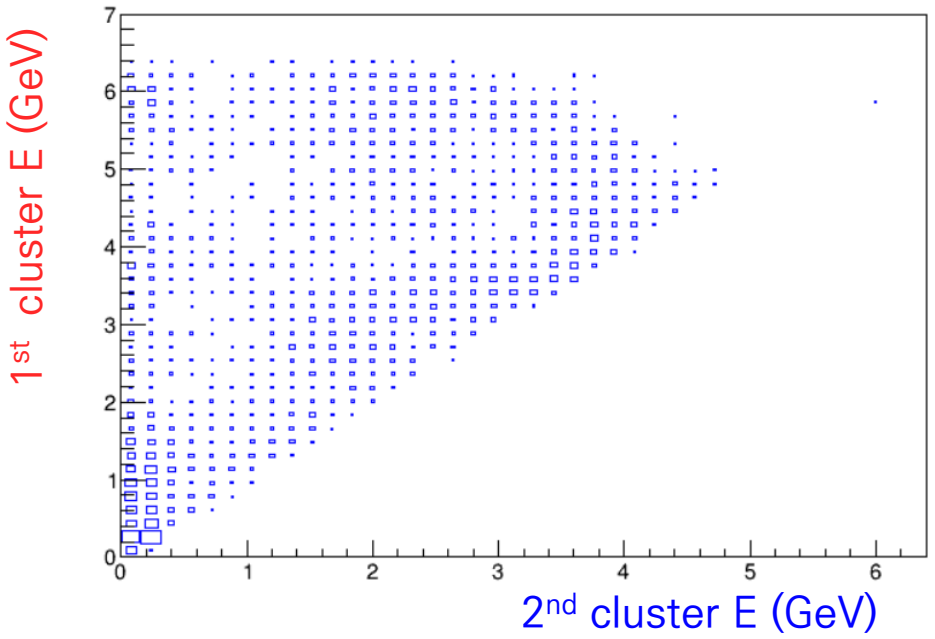
trg rates (Hz)	total	Bhabha	udsc	BB	$\mu^+\mu^-$	$e^+e^-e^+e^-$	$e^+e^-\mu^+\mu^-$	$\gamma\gamma$	$\tau^+\tau^-$
stt	580	379	78	27	25	26	24	1.3	20
stt&&1-cluster veto	552	354	78	27	25	24	23	1.3	20

The number of clusters = 2 with stt

- The energy distribution of the 1st cluster is spread flat compared with the 2nd cluster from 0 to 7 GeV.
- The energy distribution of the 2nd cluster is concentrated around 0.2 GeV.

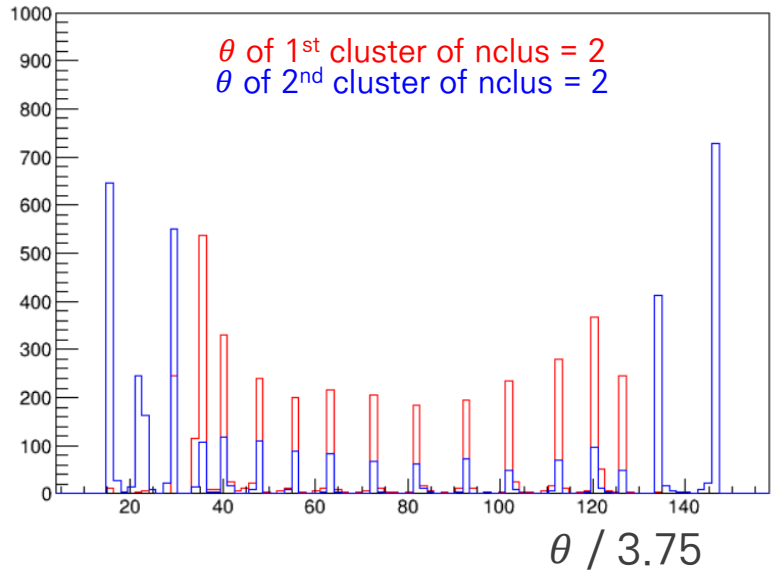


Energy dist. of 1st cluster vs 2nd cluster

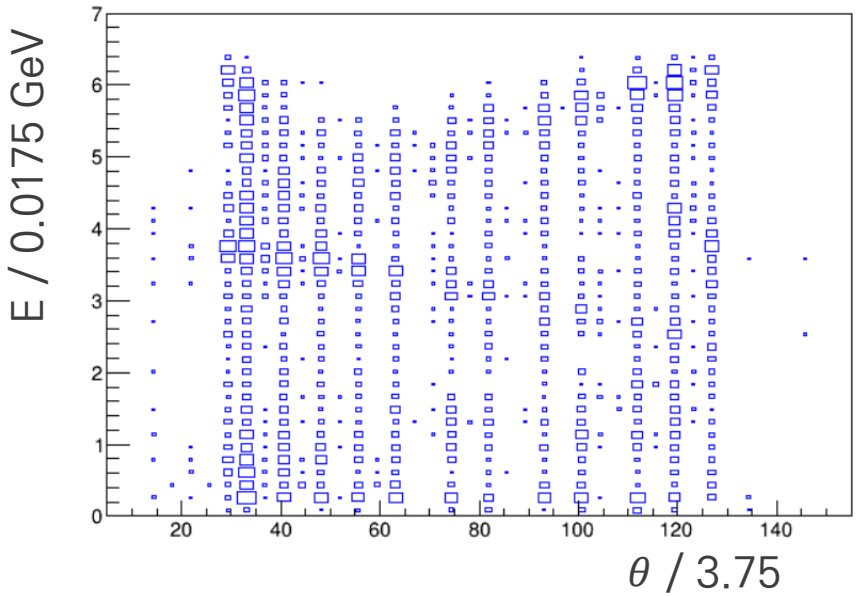


The number of clusters = 2 with stt

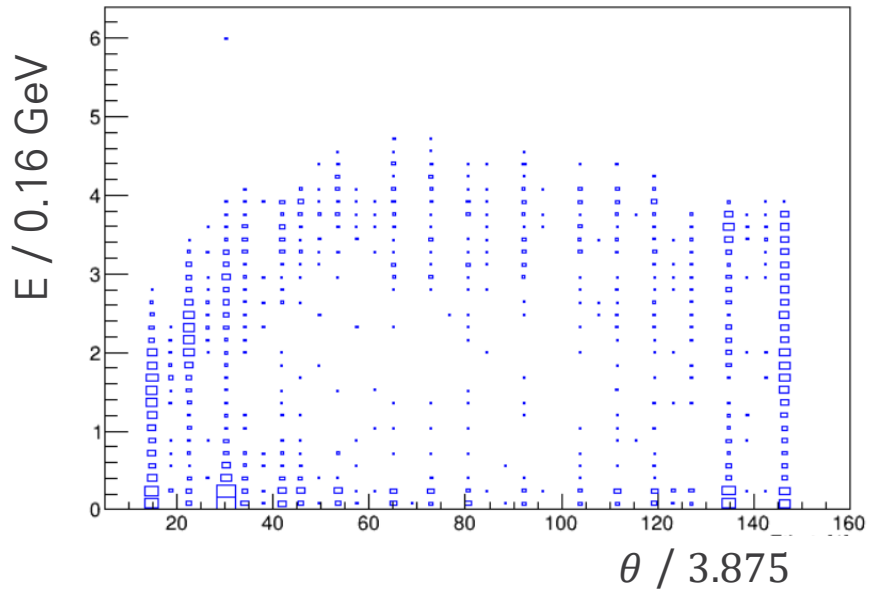
- Energy vs θ of the 2nd cluster shows that the events are on the endcaps.
- 2−cluster veto ≡ !(ncluster = 2 && ($tcid_{2nd} \geq 500$ ||$tcid_{2nd} \leq 80$)) can be applied to suppress the Bhabha events on the endcaps of the 2nd cluster.



Energy vs θ of 1st cluster



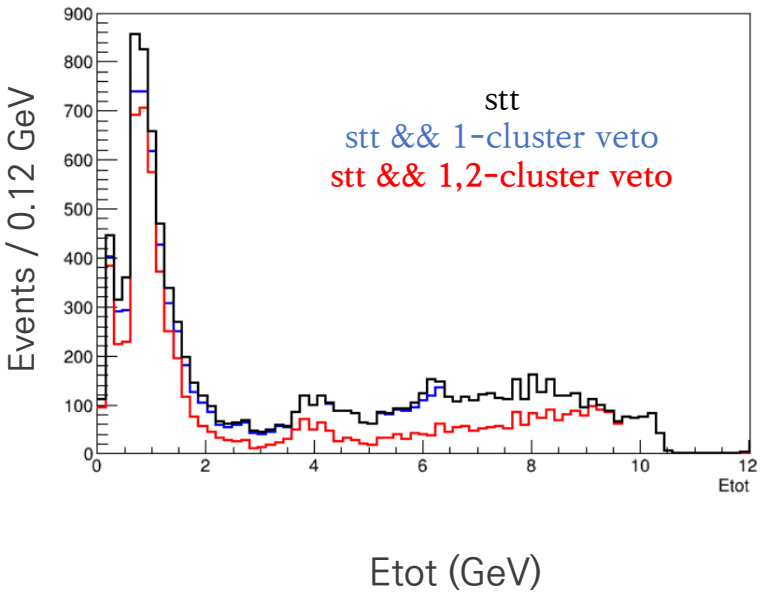
Energy vs θ of 2nd cluster



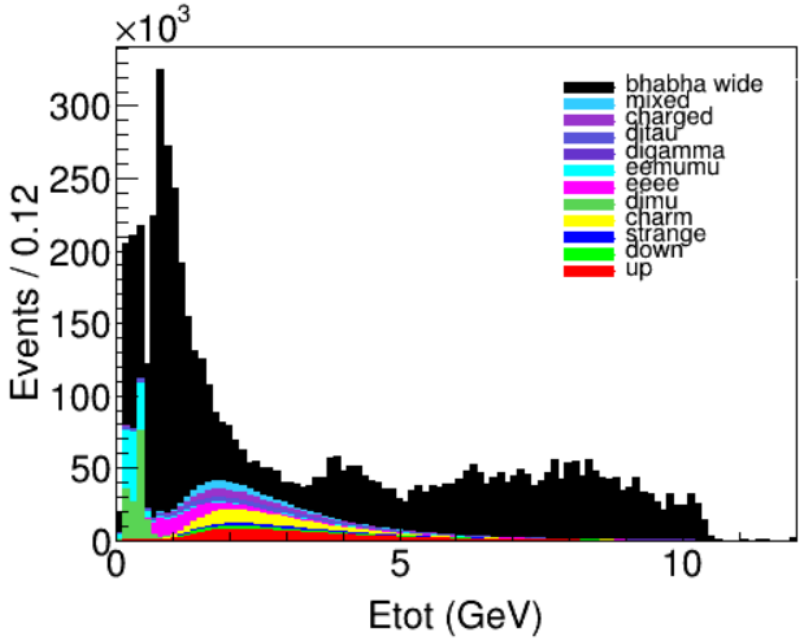
The number of clusters = 2 with stt

- stt && 1−cluster veto && 2−cluster veto (≡ !(ncluster = 2 && ($tcid_{2nd} \geq 500$ ||$tcid_{2nd} \leq 80$)))

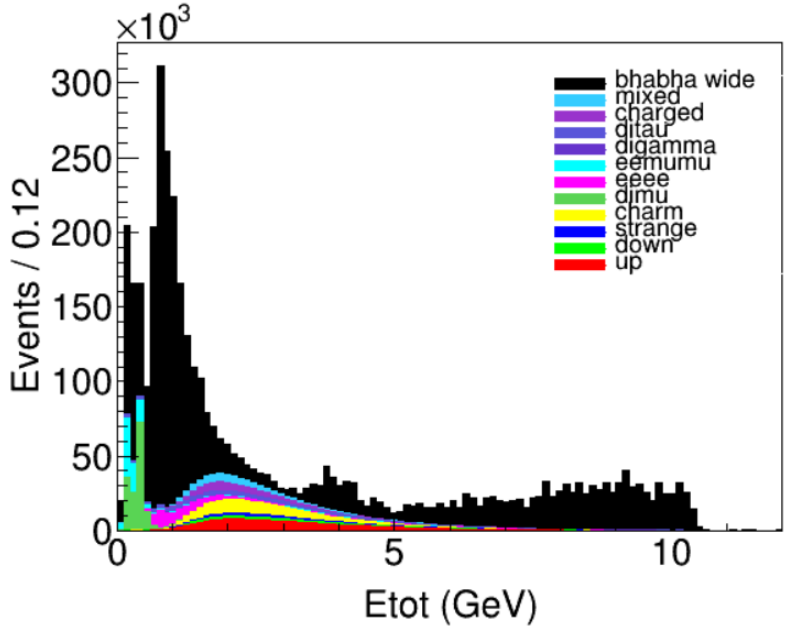
Bhabha event only



stt && 1-cluster veto



stt && 1,2-cluster veto

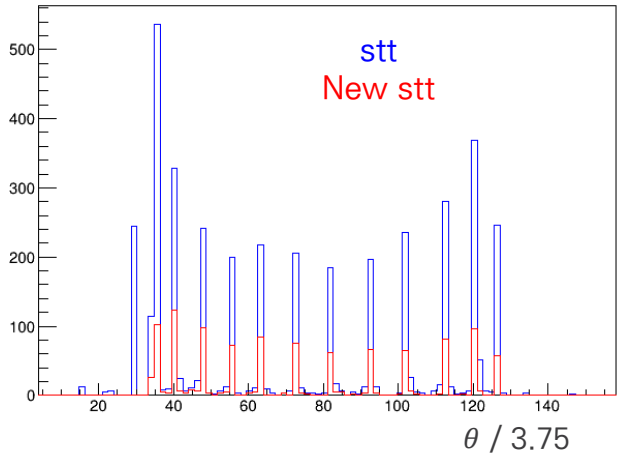


trg rates (Hz)	total	Bhabha	udsc	BB	$\mu^+\mu^-$	$e^+e^-e^+e^-$	$e^+e^-\mu^+\mu^-$	$\gamma\gamma$	$\tau^+\tau^-$
stt	580	379	78	27	25	26	24	1.3	20
stt&&1-cluster veto	552	354	78	27	25	24	23	1.3	20
stt&&1,2-cluster veto	426	248	78	27	24	16	14	1.1	19

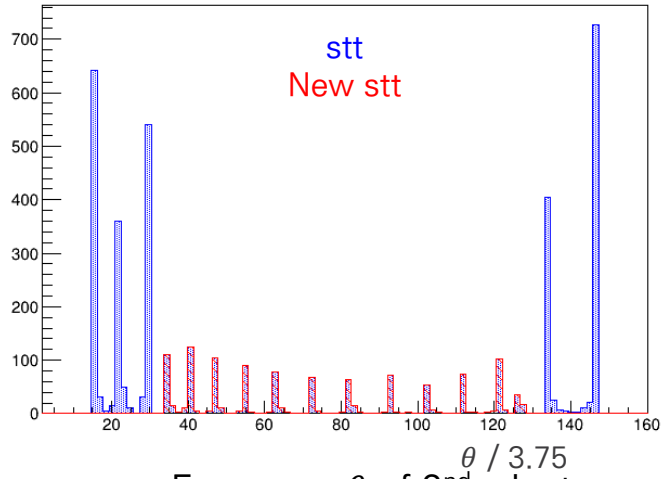
After the 2-cluster veto cut

- New stt = stt && 1−cluster veto && 2−cluster veto

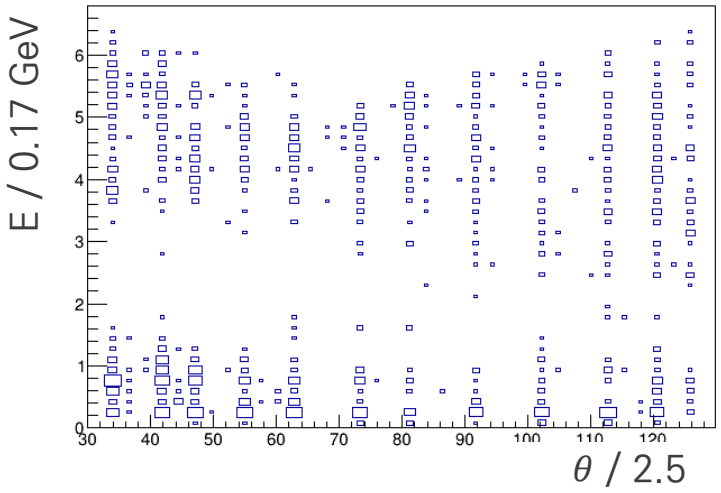
1st cluster of the ncluster = 2



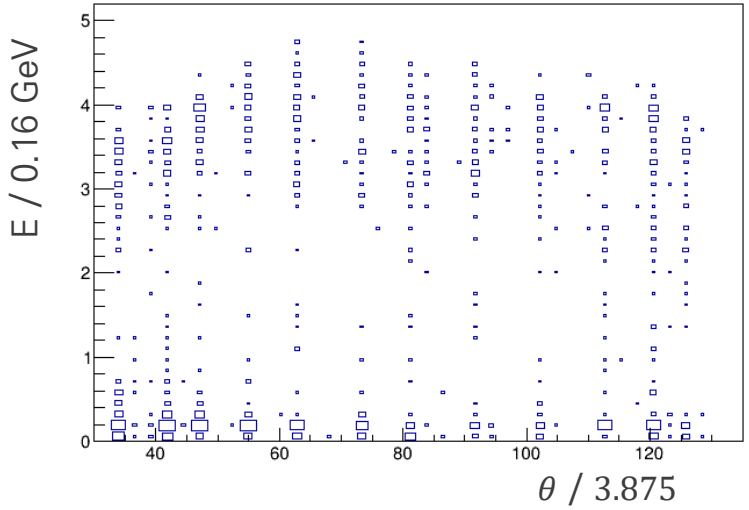
2nd cluster of the ncluster = 2



Energy vs θ of 1st cluster



Energy vs θ of 2nd cluster



Summary and next step

- To suppress the Bhabha in stt, the 1-cluster veto and 2-cluster veto have been added to the stt. The resultant trg rate of Bhabha event was 248 Hz when the instantaneous luminosity is $3 \times 10^{34}\ \mathrm{cm}^{-2}\mathrm{s}^{-1}$. The stt Bhabha trg rate reduced about 35%.

- By comparing the MC and data, the new stt cut will be checked if it is matched with data.

- From the study of the matching between track trigger and ECL trigger, more efficient variables for the stt Bhabha suppression will be studied.

Thank you!

Back up