OEC report: OEC_AtmNeutrino_update

- Remove seconday events of Atmo/Muon

Feng Gao
weekly meeting
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Atmo concept define

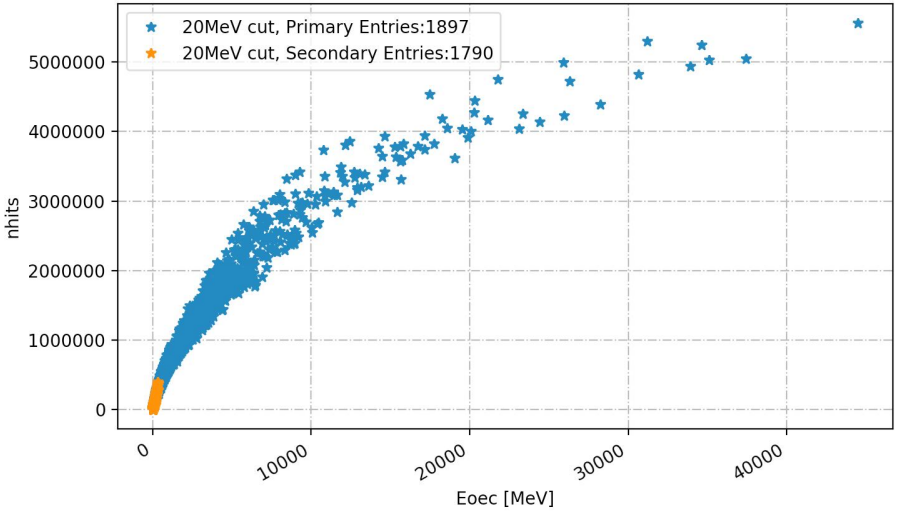
$$\text{contamination}=\frac{non\ first\ readout\ tagged\ as\ CDMoun}{total\ triggered\ readouts\ from\ elesim\ CDtrigger}$$

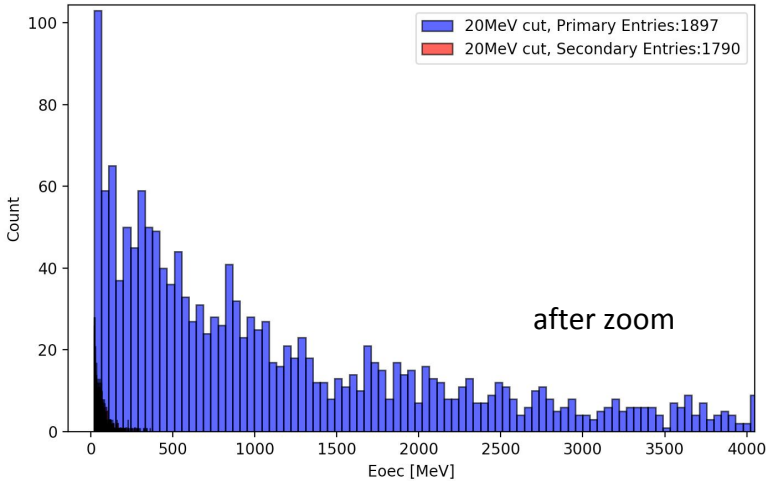
$$\text{efficiency}=\frac{first\ readout\ tagged\ as\ CDMoun}{ture\ totall\ number\ of\ atmo}$$

Atmo events

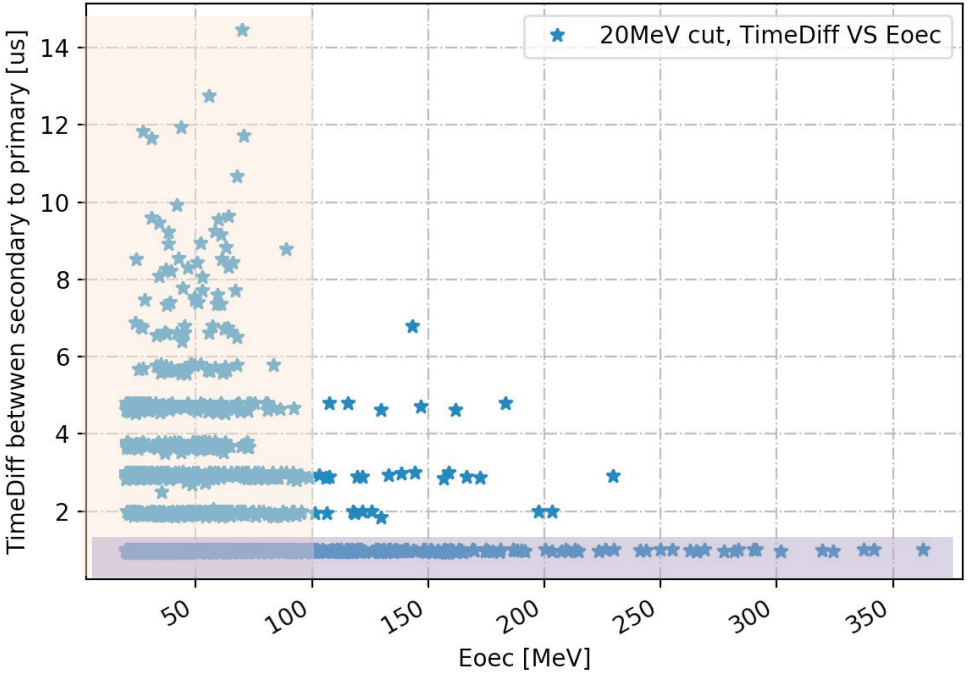
By increasing energy cut to remove contamination to <0.15% level from 8.42%

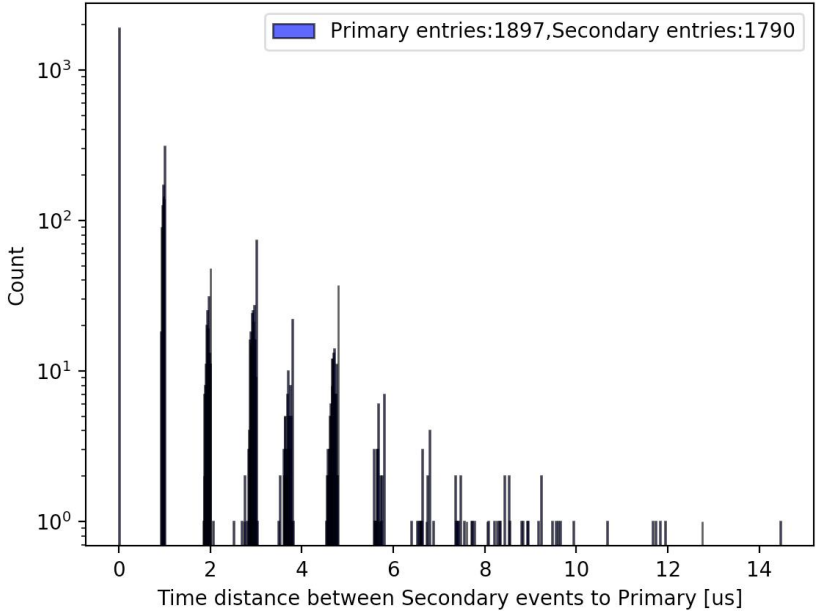
	Tagged[true Atm 2k]		wrong	total CDtrigger=21258
Cut E	events	efficiency	events	contamination
20MeV	1897	94.85%	1790	8.42%
100MeV	1748	87.4%	201	0.94%
200MeV	1623	81.15%	33	0.15%





Atmo events - remove secondary events by time



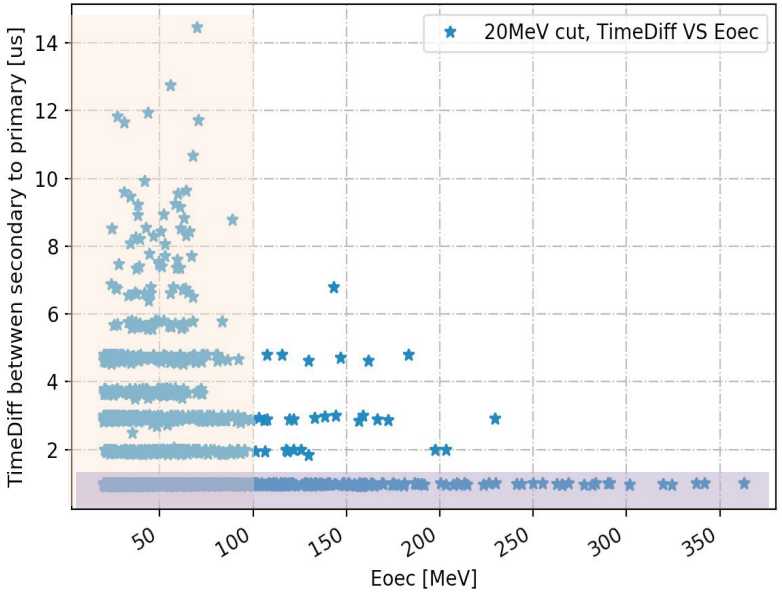


Atmo events - remove secondary events by time

Considering using 100MeV cut + 1us refuse time

- contamination rate is 0.13% for 21258 CDTrigger while 2000 Atmo generator.

time energy	20MeV		100MeV		200MeV	
	entries	rate	entries	rate	entries	rate
0	1790	8.42%	201	0.94%	33	0.15%
1us	798	3.75%	**29**	**0.13%**	2	0.009%
2us	599	2.81%	20	0.09%	1	0.004%
3us	326	1.53%	7	0.03%	0	0
4us	240	1.12%	7	0.03%	0	0

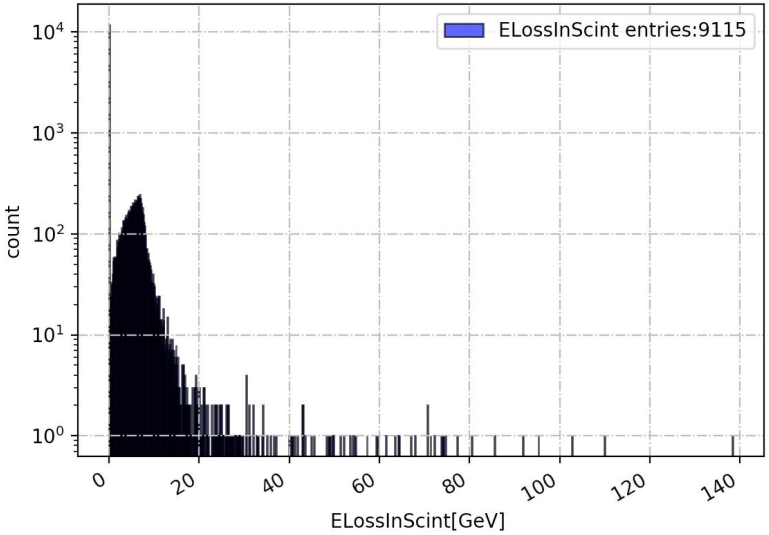


Remove Muon

- Muon’s rate in CD is 3-4Hz, the energy range is seem to Atmo’s range
- try to remove muon event as much as muon as possible
  - checking Muon events’s feature
  - applying energy cut
  - applying correlated WP trigger time vetoing

Muon Eloss in Veto/CDWater/LS

Elossin	Entries	Energy range
VetoWater	**20854**	**0-800GeV**
CDWater	12009	0-800GeV
LS	9115	0-140GeV

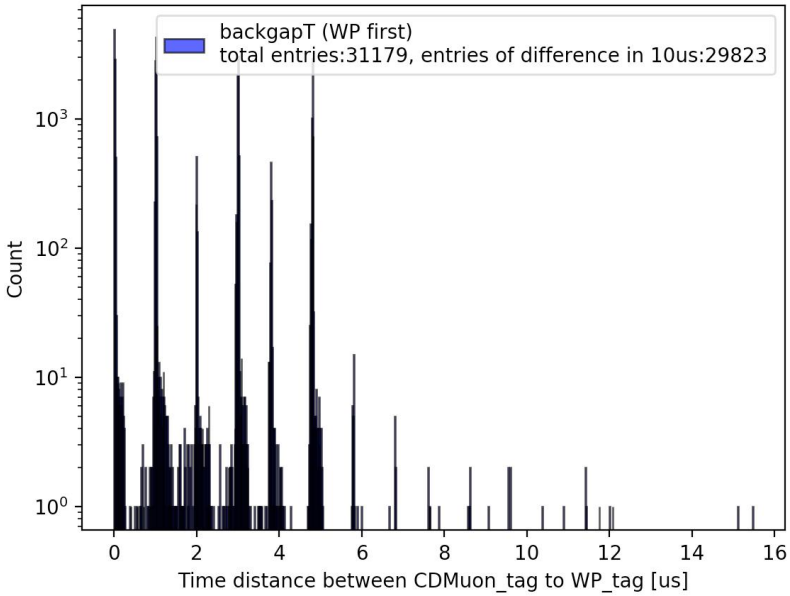


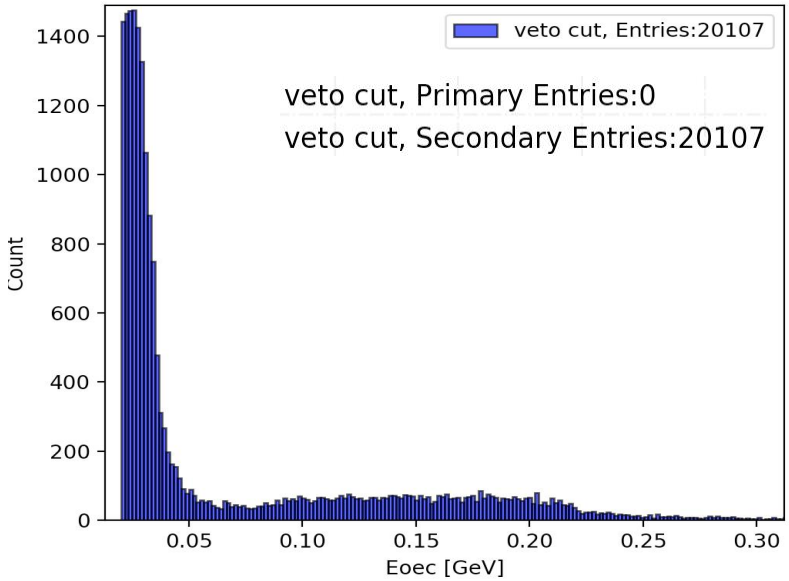
in elesim, the CD tag events is : 80567. which is used as total trigger readouts

$$\text{contamination}=\frac{all\ \ readout\ tagged\ as\ CDMoun}{total\ triggered\ readouts}$$

Muon OEC output according to WP trigger veto

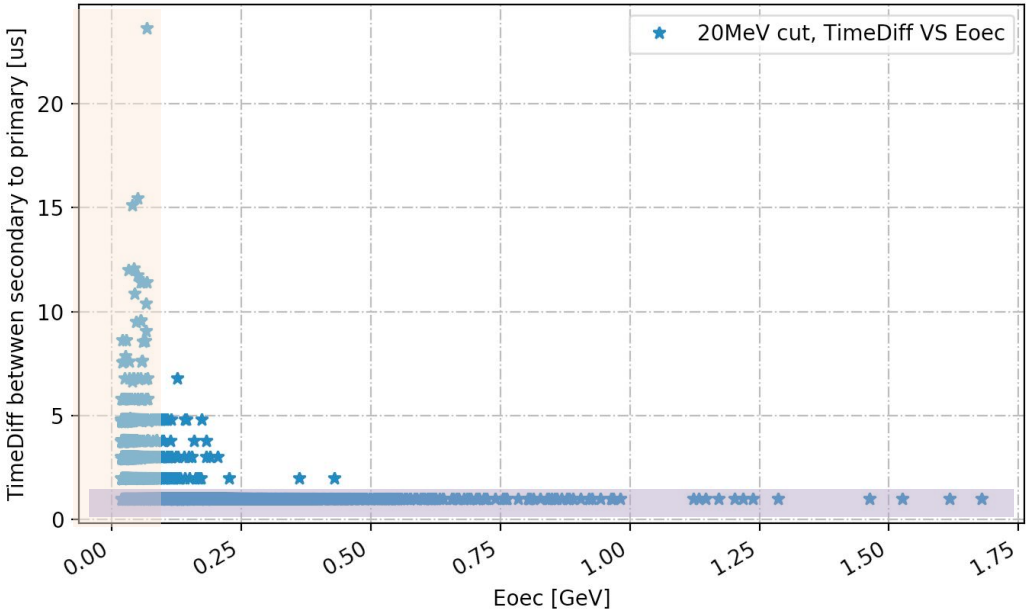
Veto time: WP before CD	Veto time: WP after CD	events+ap	contamination/80567-physik
none	none	31179+21	39.21%
1us	48ns	20107+21	24.96%
2us	48ns	10035+21	12.46%

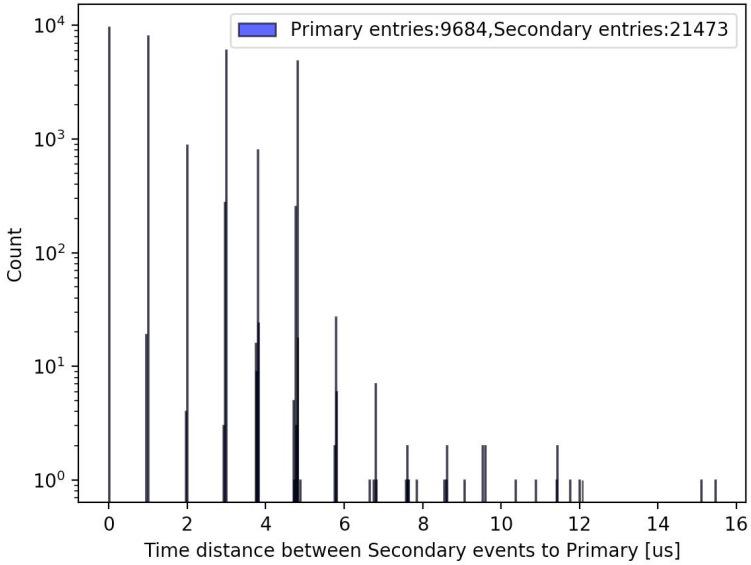




Muon events - remove secondary events by time or veto time check

veto 1us: veto all primary events, here i plot the seconday events's Eoec and Time difference between Primargy





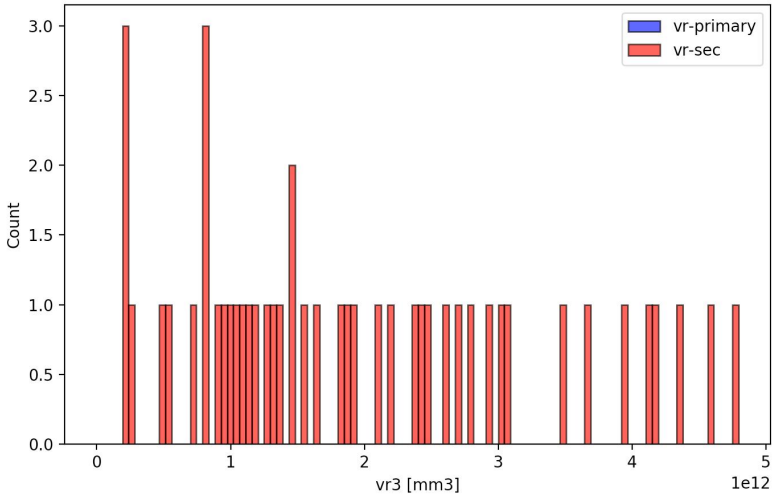
Muon events - veto + energy cut

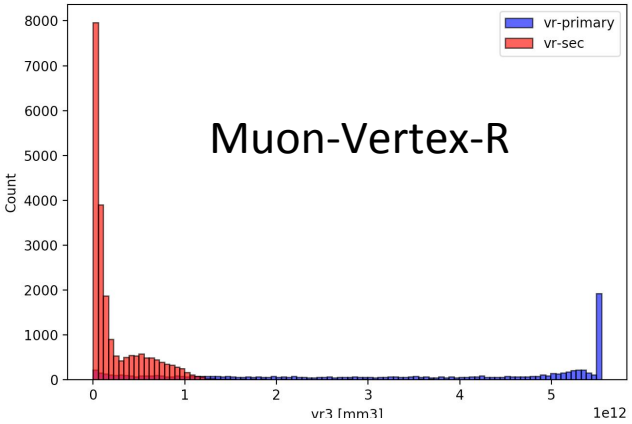
Considering using 100MeV cut + 2us veto time

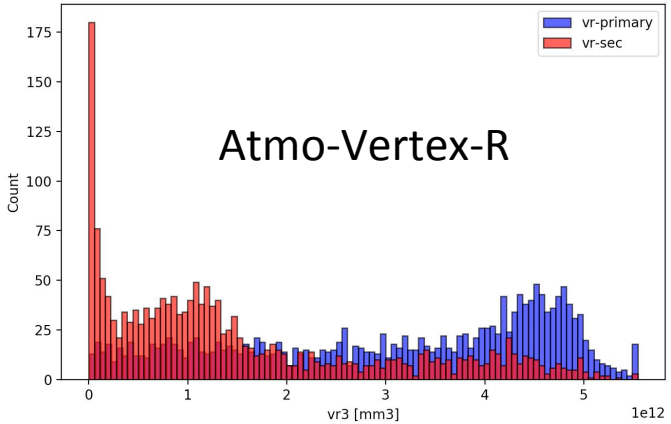
- contamination rate is 0.06%.
- AP energy is about 20-30MeV,removed by 100MeV cut.

time energy	20MeV		100MeV		200MeV	
	entries	rate	entries	rate	entries	rate
none	31179	38.69%	15281	18.96%	10523	13.06%
veto 1us	20107	24.95%	5430	6.73%	1556	1.93%
~~veto+secon 1us~~	~~13344~~	~~16.56%~~	~~51~~	~~0.06%~~	~~4~~	~~4.96e-5~~
veto 2us	13305	16.51%	46	5.70e-4	4	4.96e-5
veto 3us	10563	13.11%	26	3.22e-4	1	1.24e-5
veto 4us	5250	6.51%	8	9.92e-5	0	0
veto 5us	78	0.09%	1	1.24e-5	0	0

Muon OEC output - remain contamination:vertex

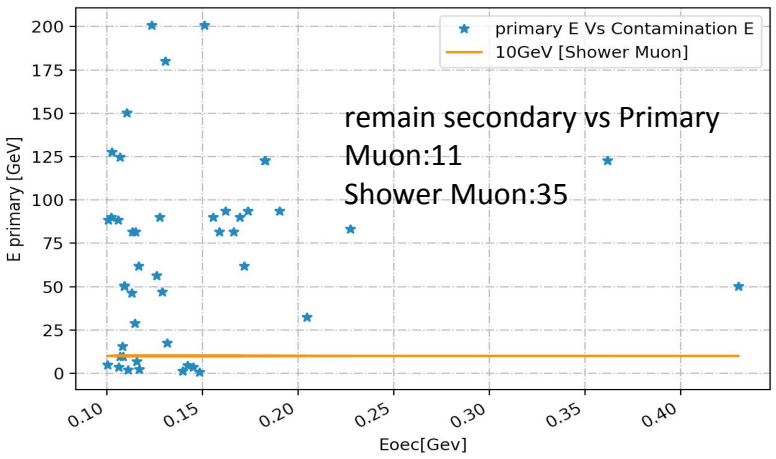


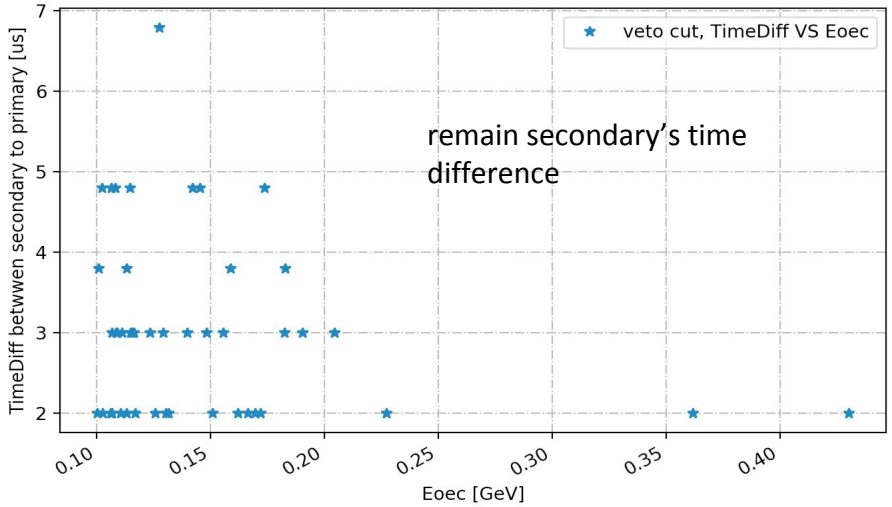


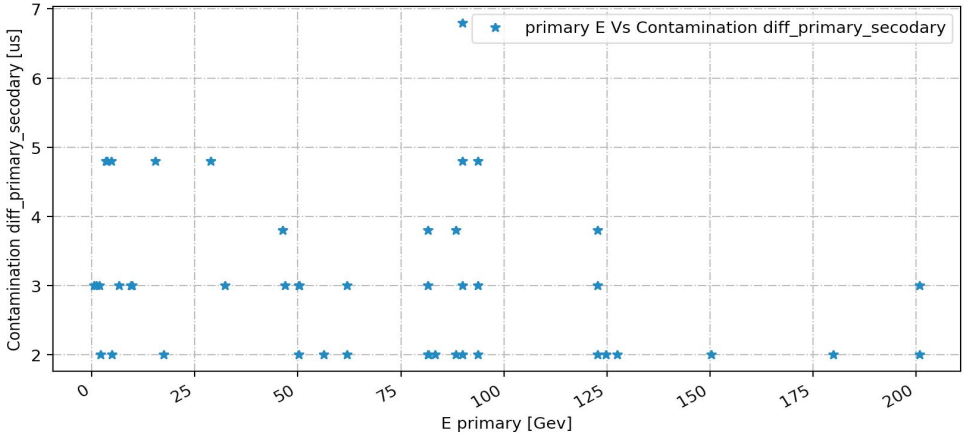


vertex cut doesn't help to remove more contamination

Muon OEC output - remain contamination







Summary and Next plan

- For Atmo events, applying energy cut(100MeV) + secondary time information(reject 1us secondry events)
  - contamination rate is 0.13% from 8.42% for 21258 CDTrigger while 2000 Atmo generator.
  - efficiency is 87.4%

- For Muon events, applying energy cut (100MeV) + WP information.
  - veto 2us: contamination rate is 5.70e-4 from 38.69%
  - veto 5us: contamination rate is 1.24e-5 .

Next plan

- check the result of J22_1_rc4, J22_2_rc2.(J22.1.rc4 for this sildes)
- The defalut trigger window in elesim is MC-truth vertex. try to use different trigger method t check the OEC result.
  - The readout window now is [-300,+700] of the trigger signal, check the performance as well with different window.[JUNO is also optimizing the window]

Software compare -muon

- check the result of J22_1_rc4, J22_2_rc2.(J22.1.rc4 for this sildes)
  - OEC performance
  - time comsuption/disk space : improved

	size[MB]	real time[h]	user time[h]	sys time[h]
J22_1	1107	535	489	15
J22_2	658	325	291	13

time energy	20MeV		100MeV		200MeV	
	entries	rate	entries	rate	entries	rate
none-J22_1	31179 (9684+21495)	38.69%	15281	18.96%	10523	13.06%
none-J22_2	27239 (9641+17598)		13841		9136	
veto 1us-J22_1	20107	24.95%	5430	6.73%	1556	1.93%
veto 1us-J22_2	16214		4269		583	