Weekly report

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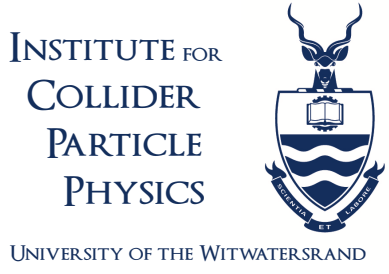
July 20, 2020



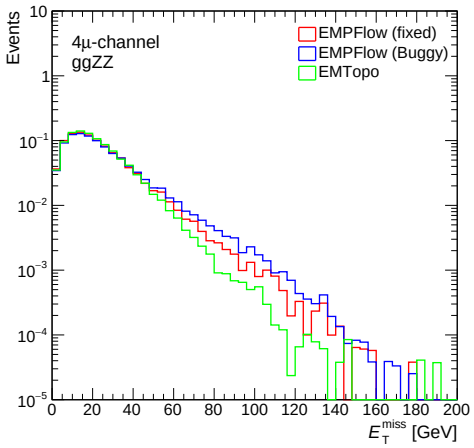
EMPFlow checks

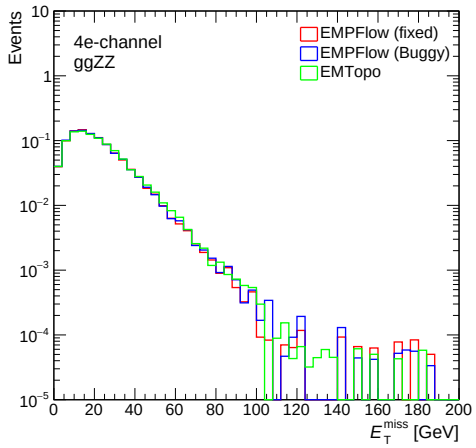
- We produced samples for testing you can find them here /eos/user/a/amoohamm/HZZMetSamples/Testing/ntuples/EMPFlow/
- There's *qqZZ*, *ggZZ* and $t\bar{t}$ samples.
- The *qqZZ* that we have is 364250, still need to add 364251 and 364252
- Also, we have test samples for some selected signal samples.

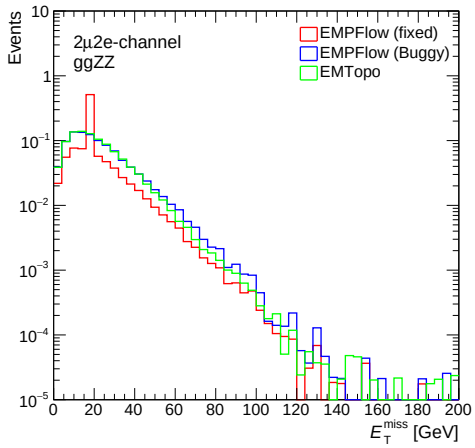
The EMPFlow's bug is solved, at least that's what the expert says, but it doesn't seem so. See backup slides. And they still asking us to do some debugging.

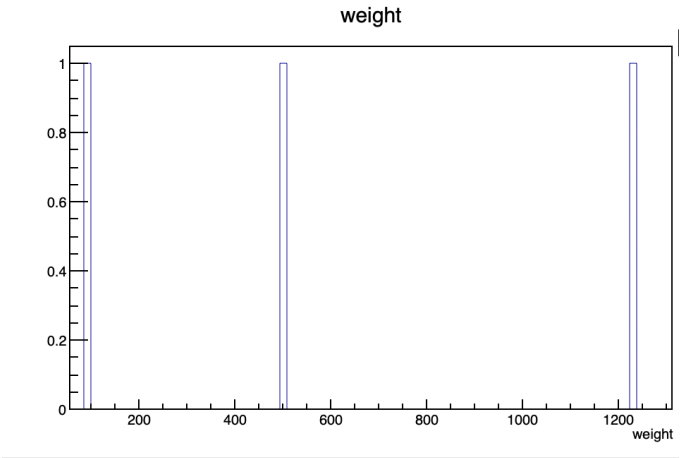
EMPFlow checks

- We found a hug weight which causing the peaks around 25 GeV









New mini-trees production

- New samples produced to check the object-based $E_{\mathrm{T}}^{\mathrm{miss}}$ significance vs event-based $E_{\mathrm{T}}^{\mathrm{miss}}$ significance.
- The samples're here /eos/user/o/omtintsi/public/HZZMetSamples/
- However, we found difference on the cutflow between old and new.

	$(m_R, m_H) = (390, 220)$	$qqZZ$	$qqZZ(EW)$	$ggZZ$	$t\bar{t}V$	$Z + jets$	$t\bar{t}$	VVV	WZ	$s/\sqrt{b}$
4ℓ	64.17±0.24	2523.28±4.48	40.67±0.15	350.23±0.72	35.56±0.45	12.95±10.85	2.78±0.22	4.73±0.37	19.18±0.12	2.605
B-veto	62.00±0.24	2446.15±4.44	37.12±0.14	341.16±0.71	7.86±0.21	12.95±10.85	1.84±0.15	4.49±0.36	18.49±0.11	2.569
$N_{\mathrm{jet}}^{\mathrm{central}} = 0$	27.92±0.16	1616.66±3.84	4.20±0.05	212.61±0.56	1.29±0.07	12.56±10.84	0.80±0.09	2.54±0.27	9.36±0.07	1.437

	$(m_R, m_H) = (390, 220)$	$qqZZ$	$qqZZ(EW)$	$ggZZ$	$t\bar{t}V$	$Z + jets$	$t\bar{t}$	VVV	WZ	$s/\sqrt{b}$
4ℓ	64.29±0.27	2516.10±4.47	2498.89±34.66	348.96±0.71	38.68±0.44	10.35±8.28	2.71±0.20	5.12±0.34	19.04±0.11	1.935
B-veto	62.15±0.27	2450.99±4.44	2326.25±33.62	341.64±0.70	8.79±0.21	10.35±8.28	1.76±0.15	4.96±0.33	18.48±0.11	1.920
$N_{\mathrm{jet}}^{\mathrm{central}} = 0$	28.17±0.18	1625.15±3.84	225.12±9.79	212.93±0.56	1.46±0.07	9.69±8.27	0.77±0.08	2.85±0.26	9.40±0.07	1.368
$p_{\mathrm{T}}^{\mathrm{jet}} > 0.00$ & Metsig > 0.00	28.17±0.18	1625.15±3.84	225.12±9.79	212.93±0.56	1.46±0.07	9.69±8.27	0.77±0.08	2.85±0.26	9.40±0.07	1.368

Figure: 0-cjets old (top) new (bottom)

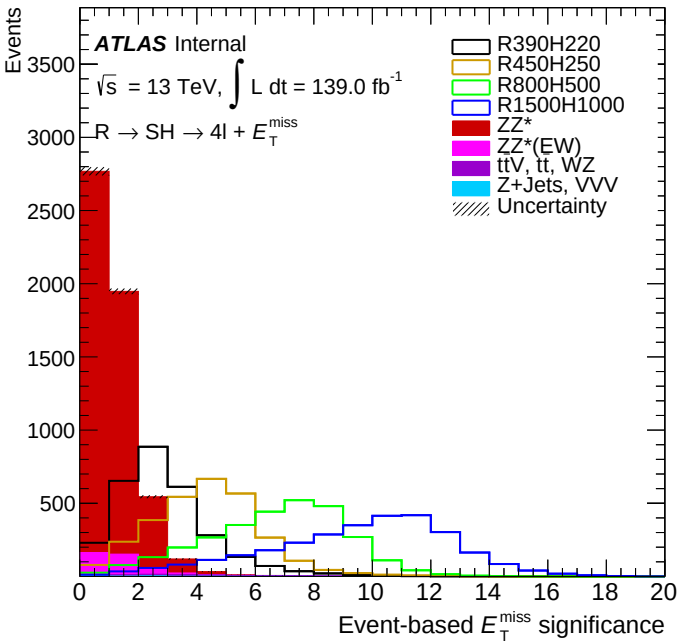
	$(m_R, m_H) = (390, 220)$	$qqZZ$	$qqZZ(EW)$	$ggZZ$	$t\bar{t}V$	$Z + jets$	$t\bar{t}$	VVV	WZ	$s/\sqrt{b}$
4ℓ	64.17±0.24	2523.28±4.48	40.67±0.15	350.23±0.72	35.56±0.45	12.95±10.85	2.78±0.22	4.73±0.37	19.18±0.12	2.605
B-veto	62.00±0.24	2446.15±4.44	37.12±0.14	341.16±0.71	7.86±0.21	12.95±10.85	1.84±0.15	4.49±0.36	18.49±0.11	2.569
$N_{\mathrm{jet}}^{\mathrm{central}} \geq 1$	34.08±0.18	829.48±2.23	32.92±0.13	128.56±0.44	6.57±0.20	0.40±0.42	1.04±0.13	1.95±0.23	9.13±0.08	2.380

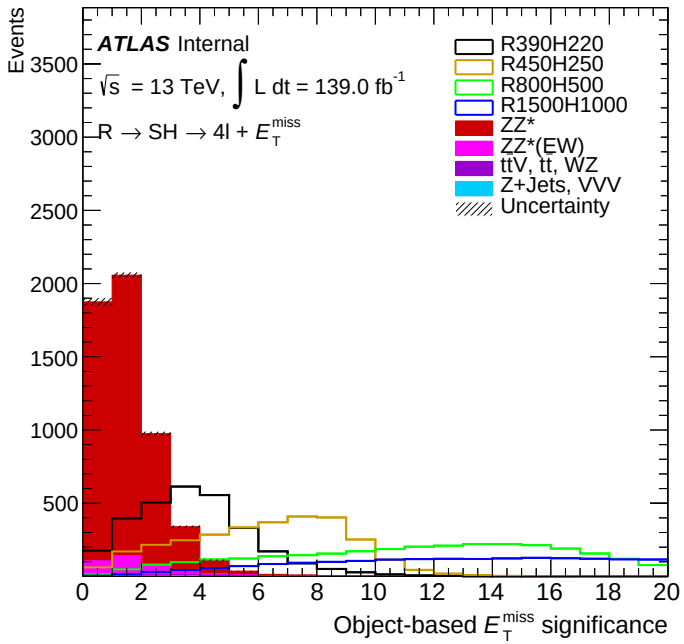
	$(m_R, m_H) = (390, 220)$	$qqZZ$	$qqZZ(EW)$	$ggZZ$	$t\bar{t}V$	$Z + jets$	$t\bar{t}$	VVV	WZ	$s/\sqrt{b}$
4ℓ	64.29±0.27	2516.10±4.47	2498.89±34.66	348.96±0.71	38.68±0.44	10.35±8.28	2.71±0.20	5.12±0.34	19.04±0.11	1.93474
B-veto	62.15±0.27	2450.99±4.44	2326.25±33.62	341.64±0.70	8.79±0.21	10.35±8.28	1.76±0.15	4.96±0.33	18.48±0.11	1.91980
$N_{\mathrm{jet}}^{\mathrm{central}} \geq 1$	33.99±0.20	825.84±2.21	2101.14±32.16	128.71±0.43	7.33±0.20	0.66±0.35	0.99±0.12	2.11±0.21	9.08±0.08	1.36014
$p_{\mathrm{T}}^{\mathrm{jet}} > 0.00$ GeV & Metsig > 0.00	33.99±0.20	825.84±2.21	2101.14±32.16	128.71±0.43	7.33±0.20	0.66±0.35	0.99±0.12	2.11±0.21	9.08±0.08	1.36014

Figure: 1-cjets old (top) new (bottom)

New mini-trees production

Kinematic distributions

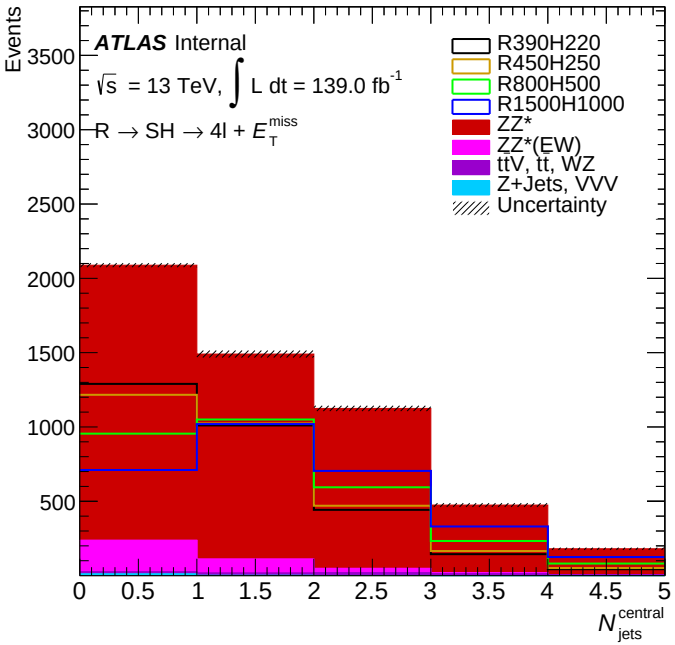


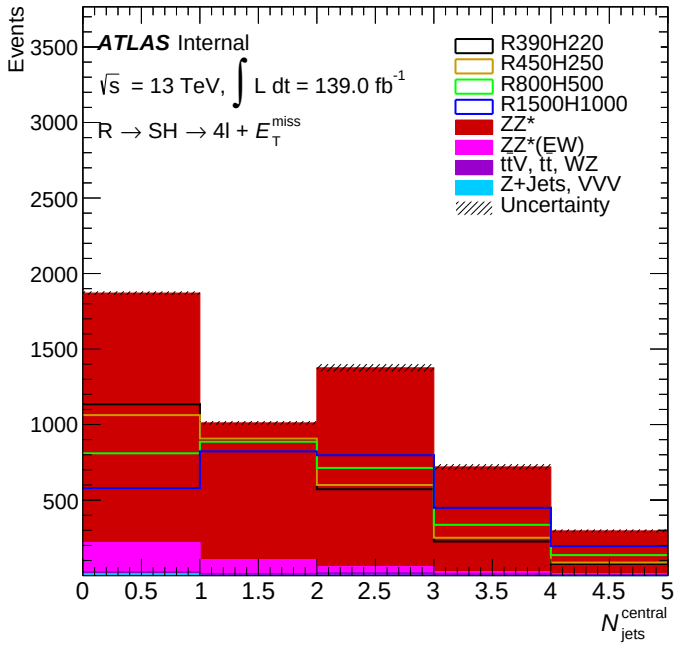


- Object-based $E_{\mathrm{T}}^{\mathrm{miss}}$ significance tends to favour high values

New mini-trees production

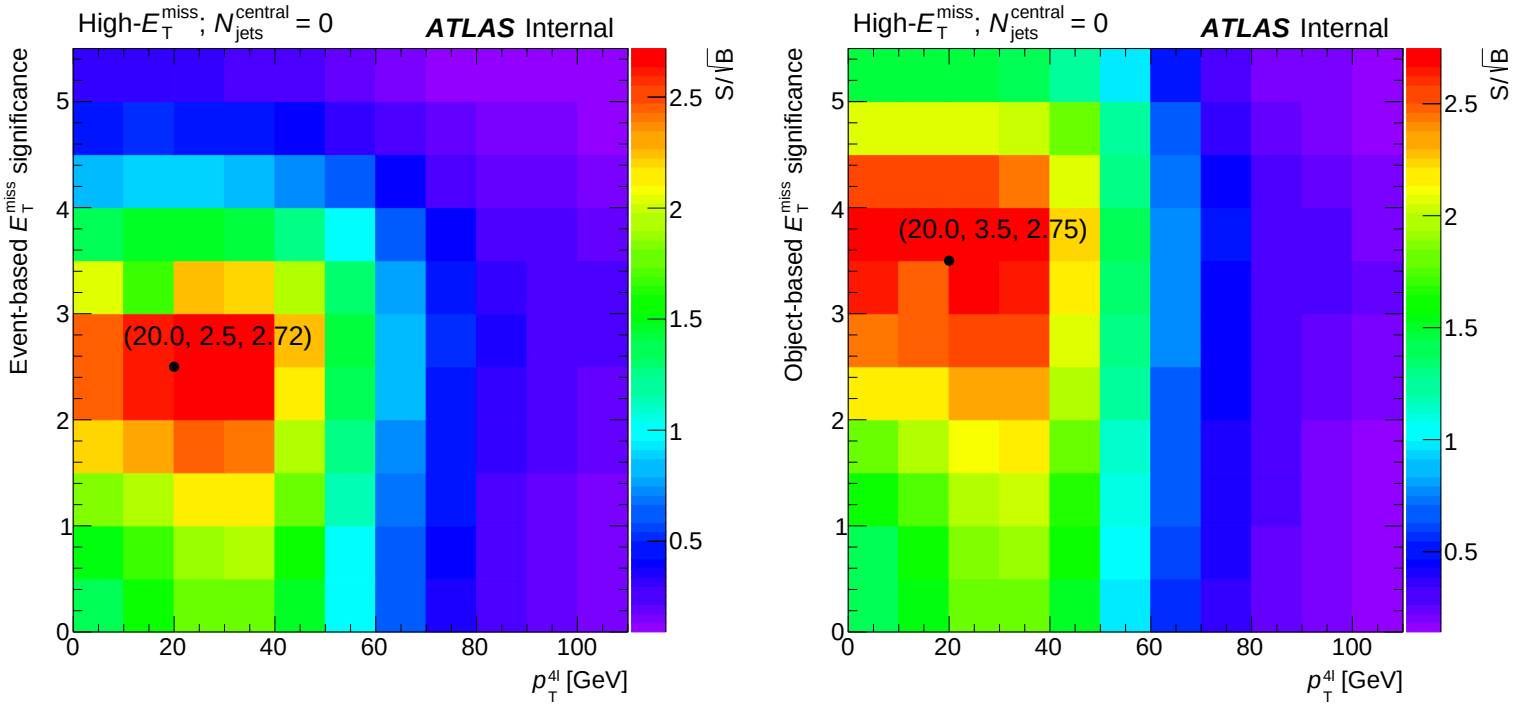
Kinematic distributions





- The "n_cjets" branch is not filled properly (please don't use it for now)

Object-based $E_{\mathrm{T}}^{\mathrm{miss}}$ significance



- Using the new samples the object-based $E_{\mathrm{T}}^{\mathrm{miss}}$ significance improves the significance by about 1%

Summary

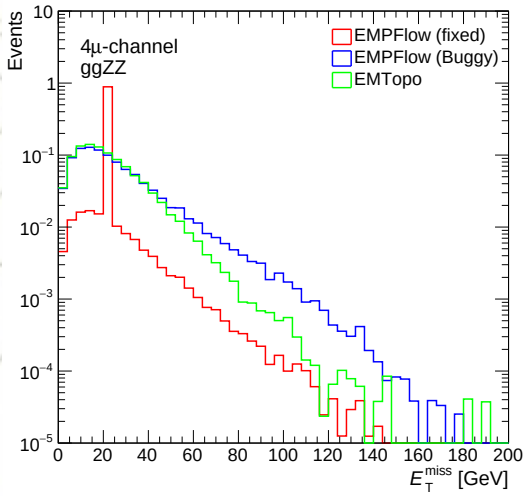
- We need to check the new mini-trees to see why they have more events.
- There's a little improvement on the significance when we use the object-based $E_{\mathrm{T}}^{\mathrm{miss}}$ significance. Perhaps is too early to come up with a conclusion.
- Now what will be the plan for the code that we're developing?

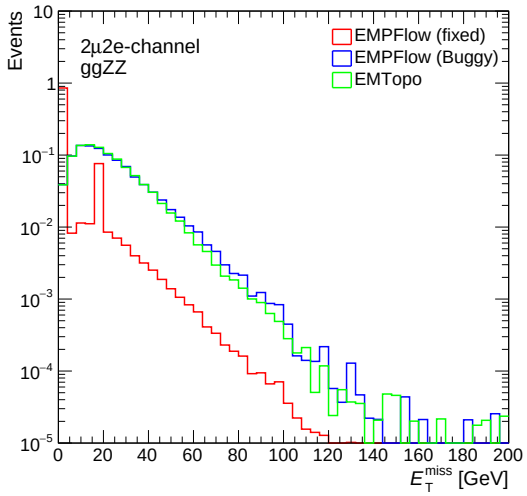
To do next . . .

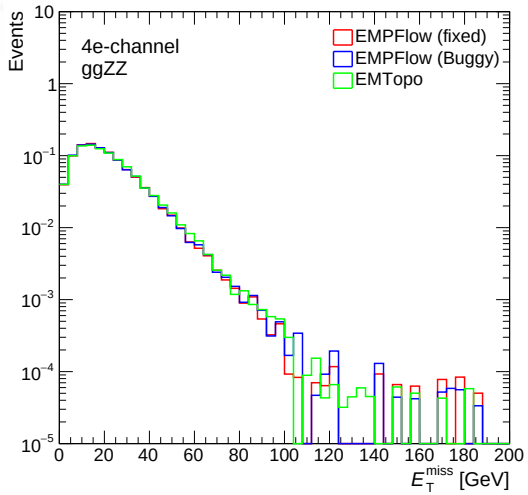
- I'm going to focus documenting what we did so far on the note.
- Also, get the expected limit for the 9 mass point that we have.

Thank you!

Additional slides
Met distribution for *ggZZ*

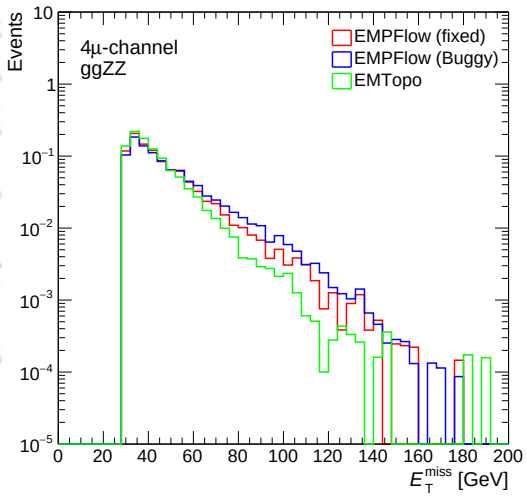


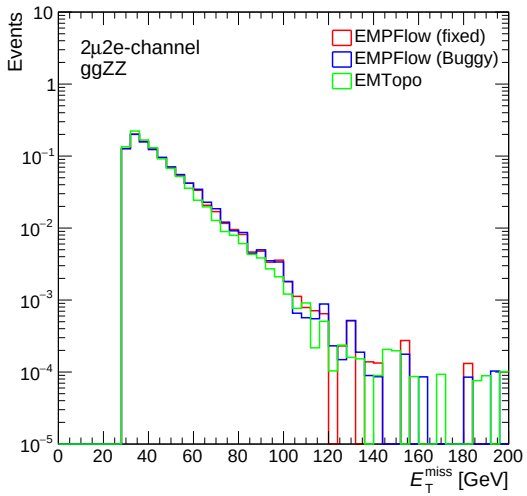


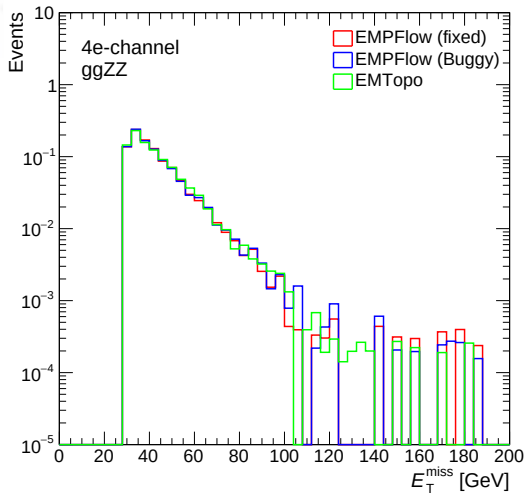


Additional slides

After applying a 30 GeV cut on the Met







Additional slides

Event Selection	
Quadruplet Selection	- Require at least one quadruplet of leptons consisting of two pairs of same-flavour opposite-charge leptons fulfilling the following requirements: - p_T thresholds for three leading leptons in the quadruplet: 20, 15 and 10 GeV - Maximum one calo-tagged or stand-alone muon or silicon-associated forward per quadruplet - Leading di-lepton mass requirement: $50 < m_{12} < 106$ GeV - Sub-leading di-lepton mass requirement: $m_{\text{threshold}} < m_{34} < 115$ GeV - $\Delta R(\ell, \ell') > 0.10$ for all leptons in the quadruplet - Remove quadruplet if alternative same-flavour opposite-charge di-lepton gives $m_{\ell\ell} < 5$ GeV - Keep all quadruplets passing the above selection
Isolation	- Contribution from the other leptons of the quadruplet is subtracted - FixedCutPFlowLoose WP for all leptons
Impact Parameter Significance	- Apply impact parameter significance cut to all leptons of the quadruplet - For electrons: $d_0/\sigma_{d_0} < 5$ - For muons: $d_0/\sigma_{d_0} < 3$
Best Quadruplet	- If more than one quadruplet has been selected, choose the quadruplet with highest Higgs decay ME according to channel: 4μ, $2e2\mu$, $2\mu2e$ and $4e$
Vertex Selection	- Require a common vertex for the leptons: - χ^2/ndof < 5 for 4μ and < 9 for others decay channels