Validation of Y^{++} samples production

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3-3-1 Models in a Nutshell

A possible extension of SM with additional gauge group → 3-3-1 Model based on:

$$SU(3)_c \times SU(3)_L \times U(1)_X$$

One possible imprlementation by Corcella,Costantini,Coriano` and Frampton in

Phys.Lett. B785 (2018) 73-83 : arXiv:1806.0453

Phys.Lett. B773 (2017) 544-552 arXiv:1707.01381

→ Many BSM particles introduced:

Exotic quarks, Z', single charged higgs

and 2 vector-like doublets (Y++,Y+)

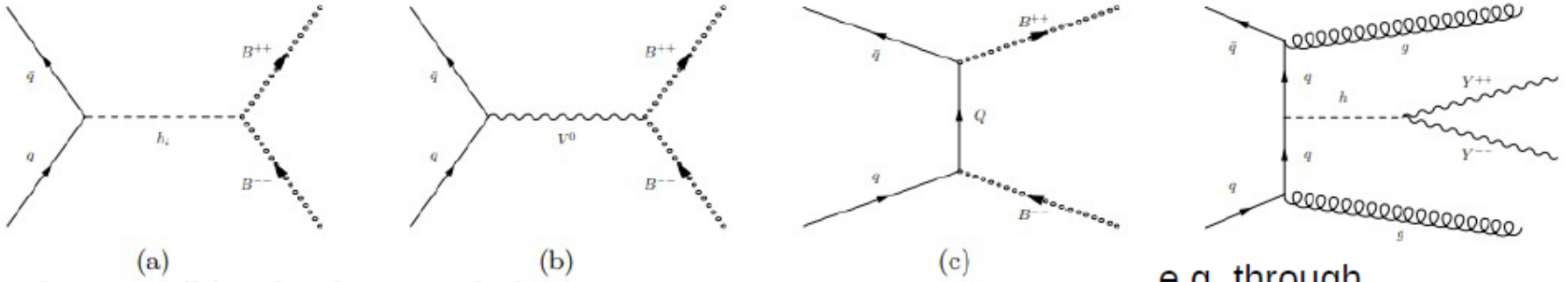
To this model the mass of Y^{++} is required to be equal to the mass of the H^{++}.

Beside theoretical motivations, what is important is to understand wether we are equally sensible to spin-1 doubly charged boson wrt spin-0 → broaden the analysis

Can we distinguish spin-0 vs spin-1 doubly charged Higgs?

Double Charged Vector Like Production (Y++)

Y++ (or B++) are produced via s-channel or though a t-channel exchange of an exotic quark



Production possible also in association with 2 (light) jets

e.g. through intermediate Higgs sector

For the moment, one benchmark point choosen compatible with current exclusion limits in different sectors

$$\sigma(pp \to Y^{++}Y^{--}) = 4.3\text{fb}$$
$$\sigma(pp \to Y^{++}Y^{--}jj) = 3.7\text{fb}$$

Lepton universality in Y++ decay:

$$\text{BR}(Y^{++} \to e^+e^+) = \text{BR}(Y^{++} \to \mu^+\mu^+) =$$
$$= \text{BR}(Y^{++} \to \tau^+\tau^+) = 1/3$$

Two sets of Y++ mechanism

H^{++} is NOT coupled with Z'

Mass point (GeV)	Cross-section
772	0.05571 ± 9.375e-05 pb
878	0.03050 ± 4.989e-05 pb
989	0.01680 ± 2.346e-05 pb

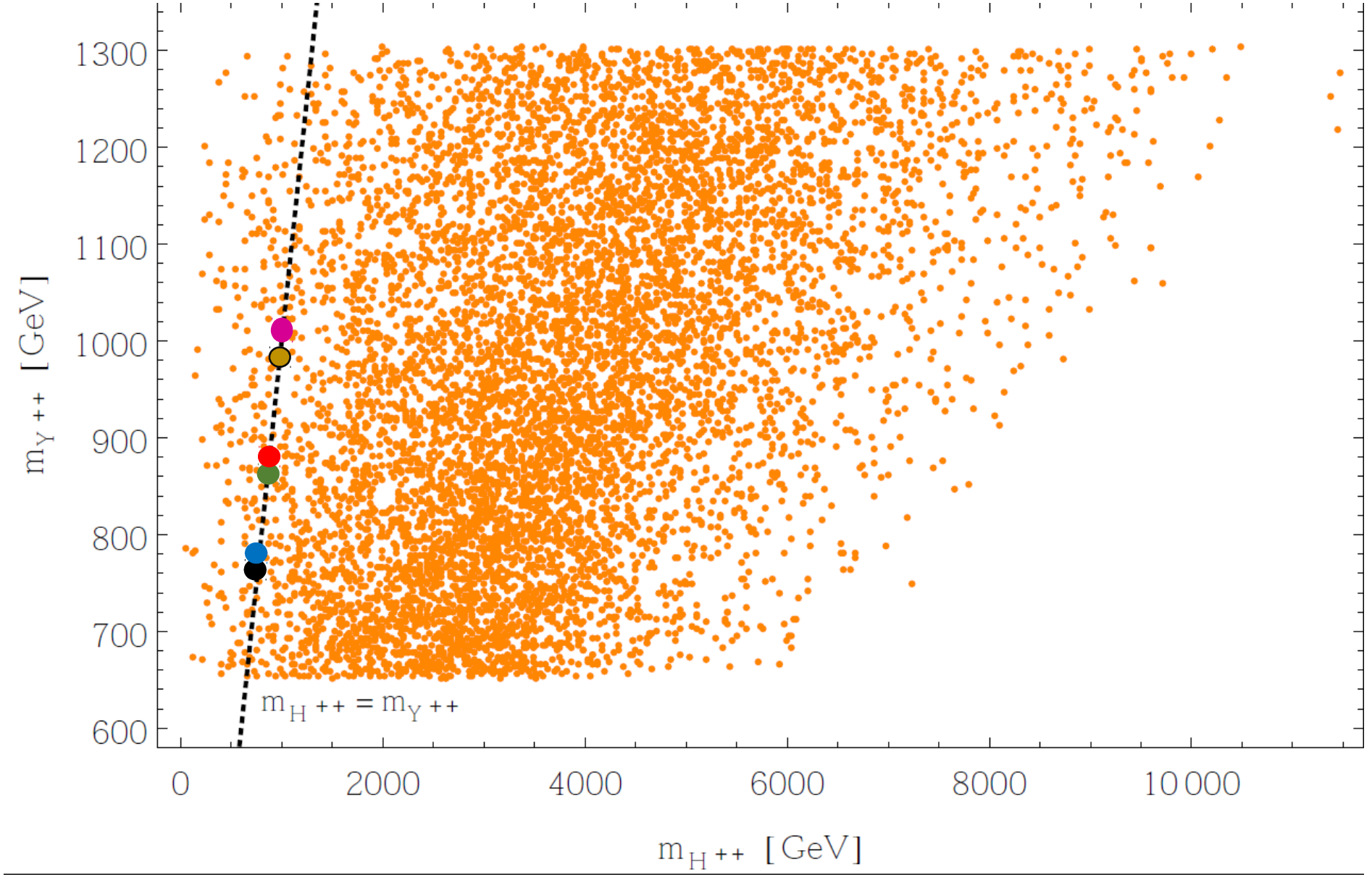
H^{++} is coupled with Z'

Mass point (GeV)	Cross-section
776	0.05453 ± 0.0001064 pb
869	0.03205 ± 5.318e-05 pb
1046	0.01234 ± 1.903e-05 pb

Using two different mechanisms, the cross-sections are similiar to each other.

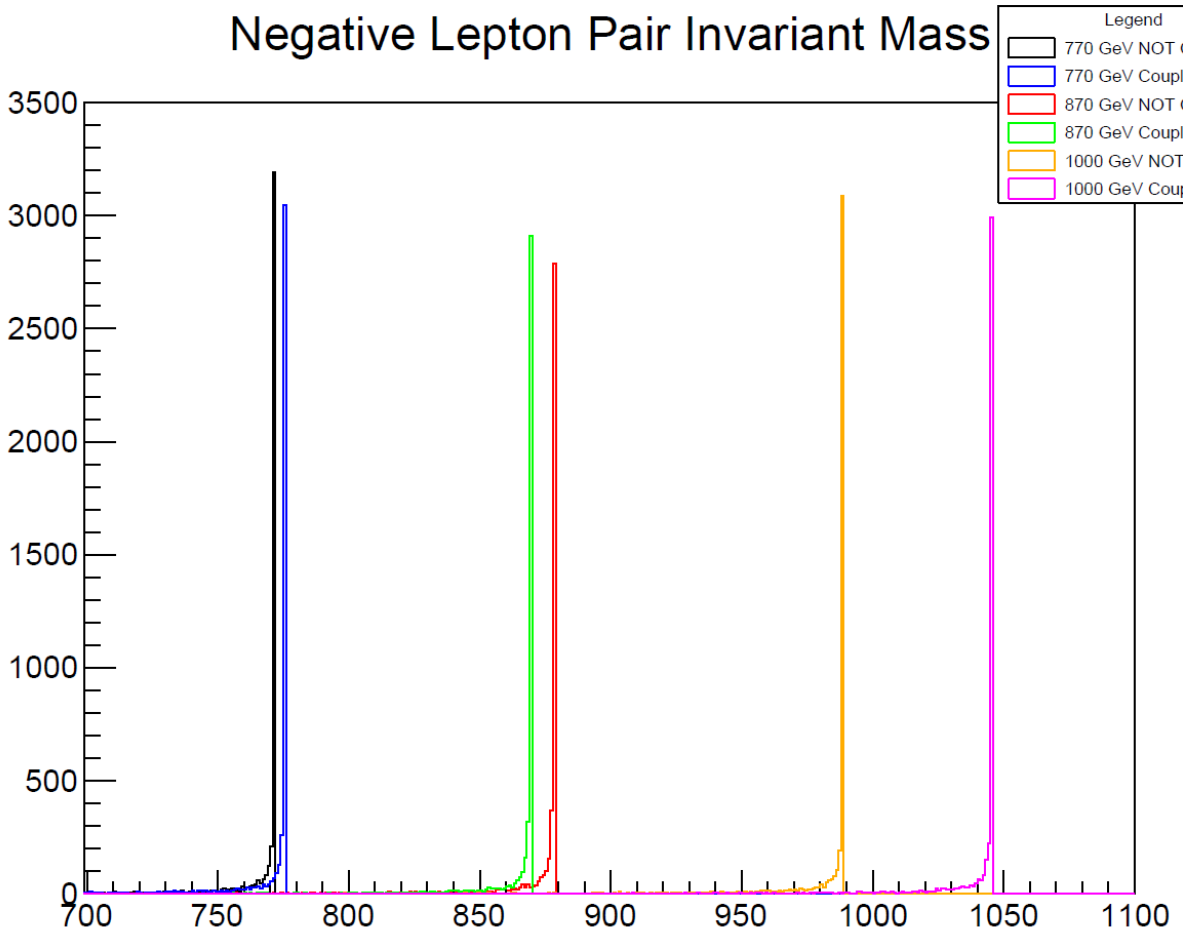
Dependence on the masses

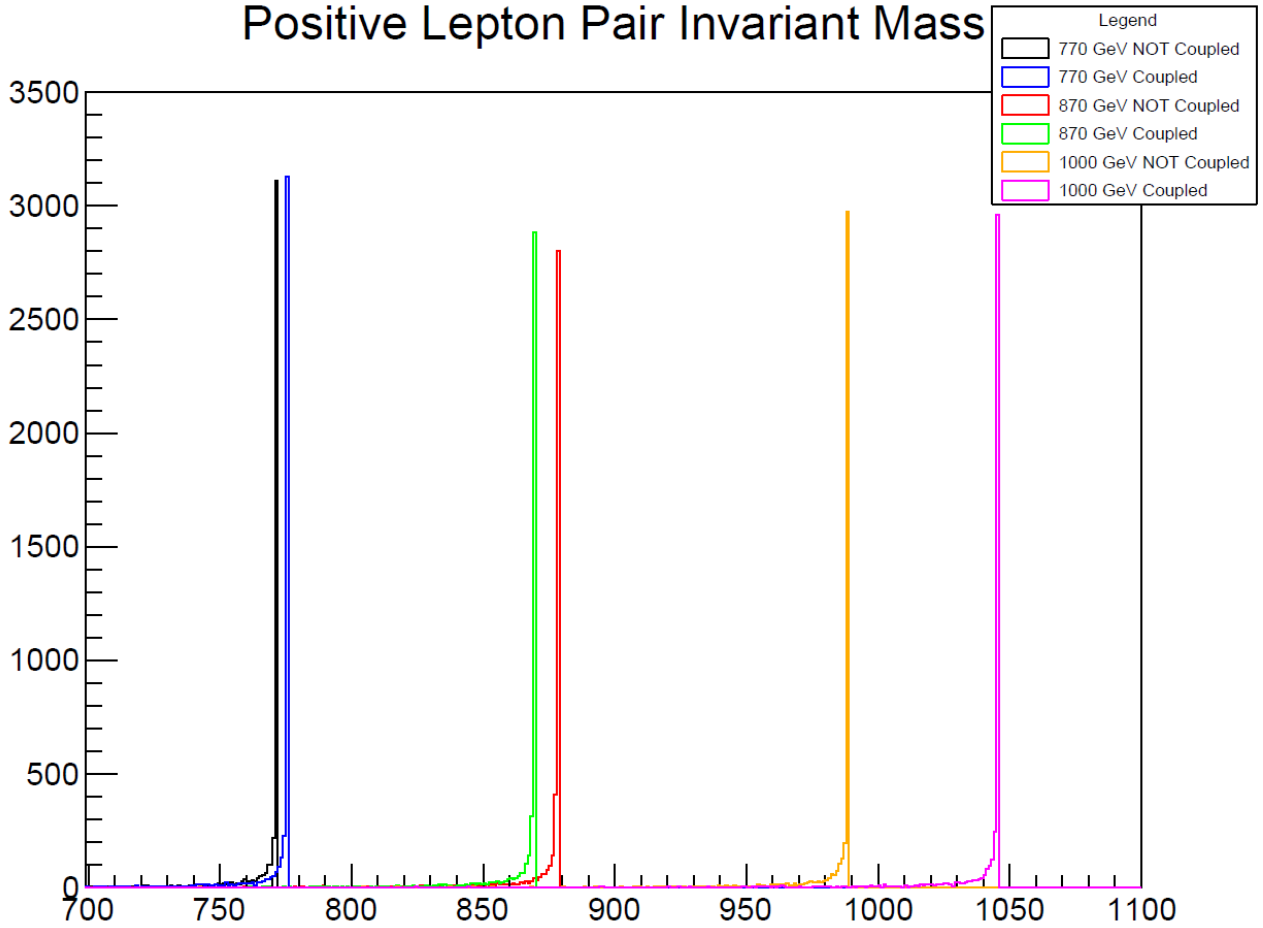
1046 GeV
989 GeV
878 GeV
869 GeV
776 GeV
772 GeV



Invariant Masses

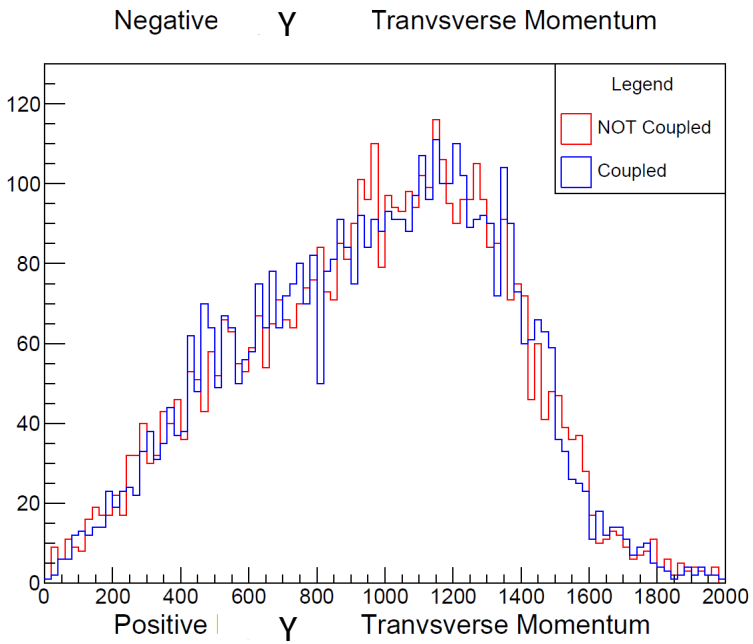
772 GeV 776 GeV 869 GeV 878 GeV 989 GeV 1046 GeV

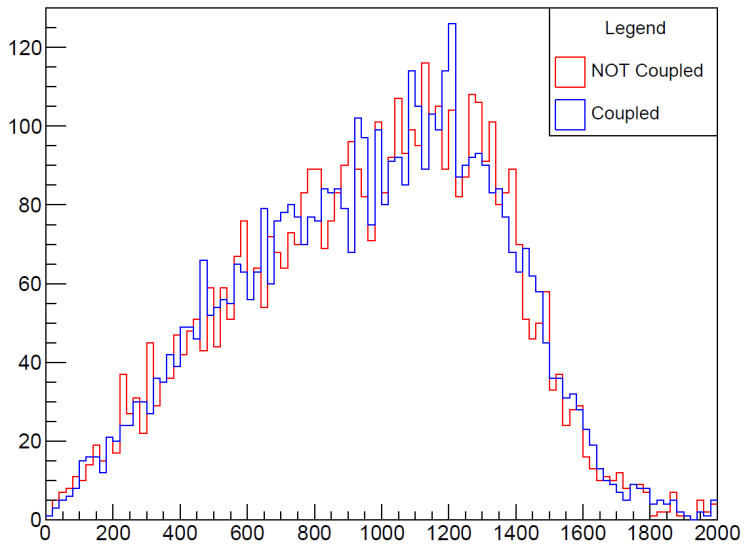




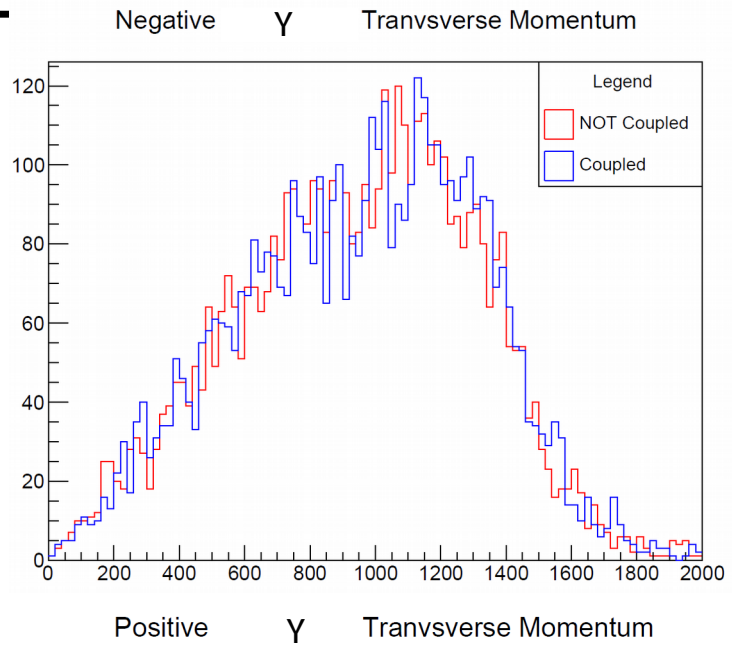
Y^{++} and Y^{--} transverse momentum

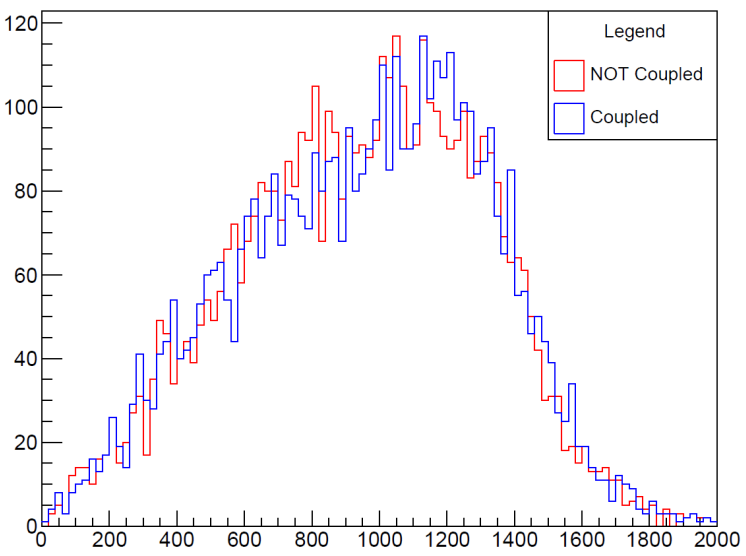
770 GeV



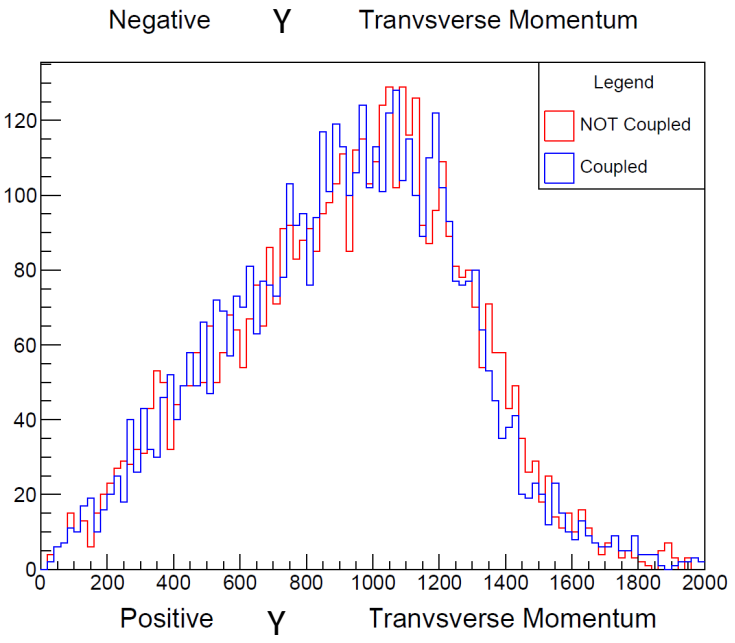


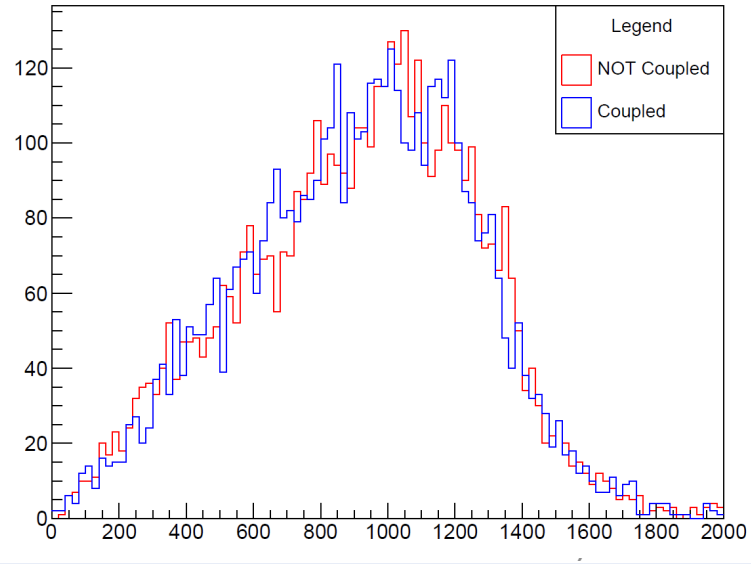
870 GeV





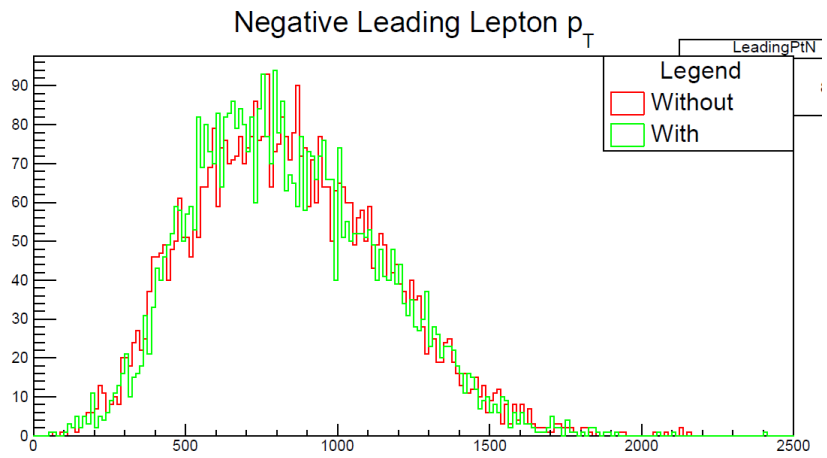
970 GeV

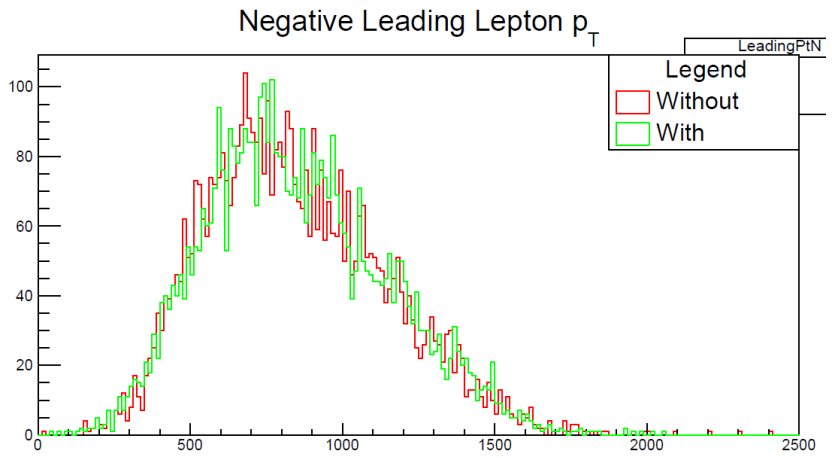


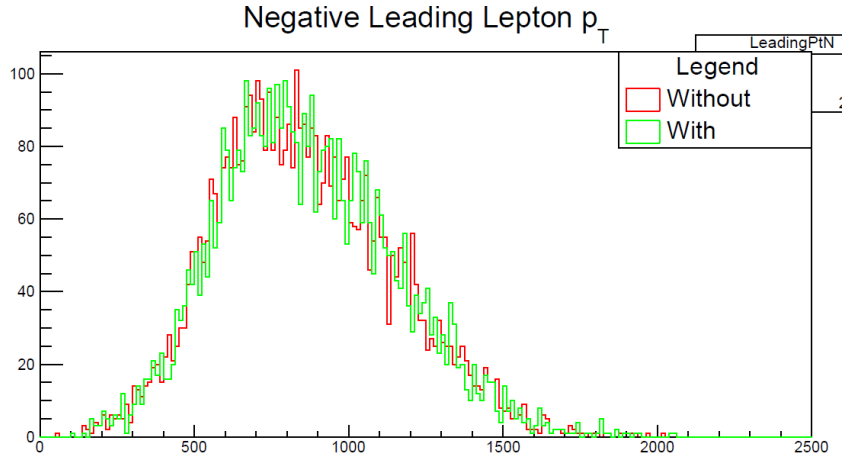


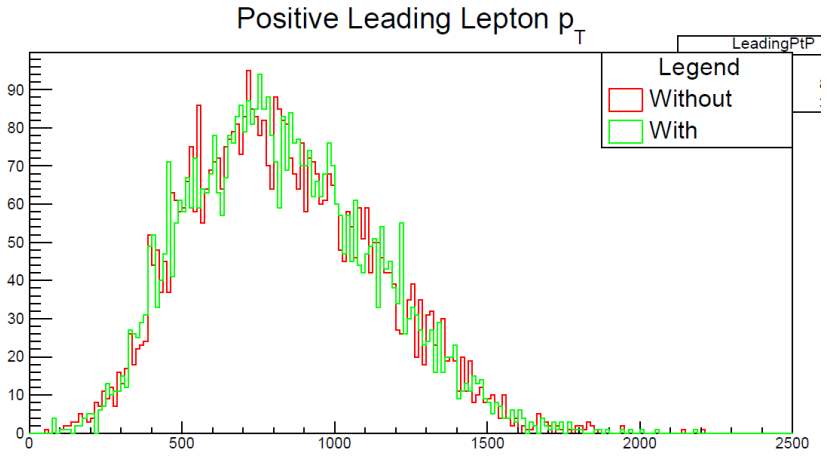
Leading Lepton Pt

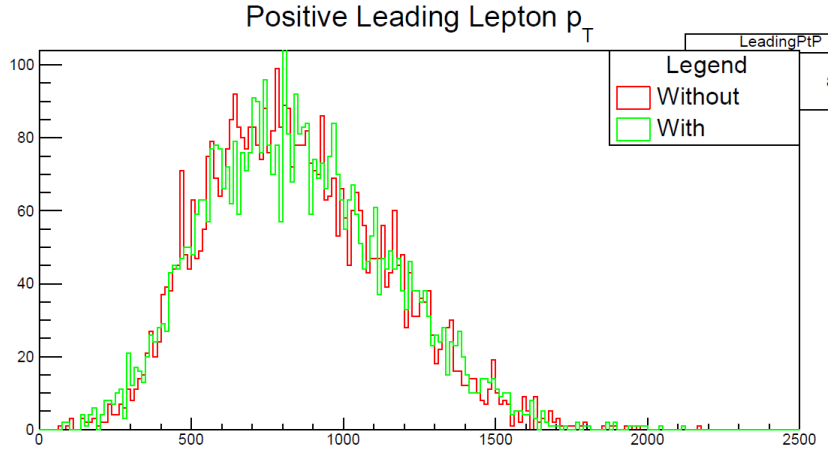
770 GeV	870 GeV	970 GeV

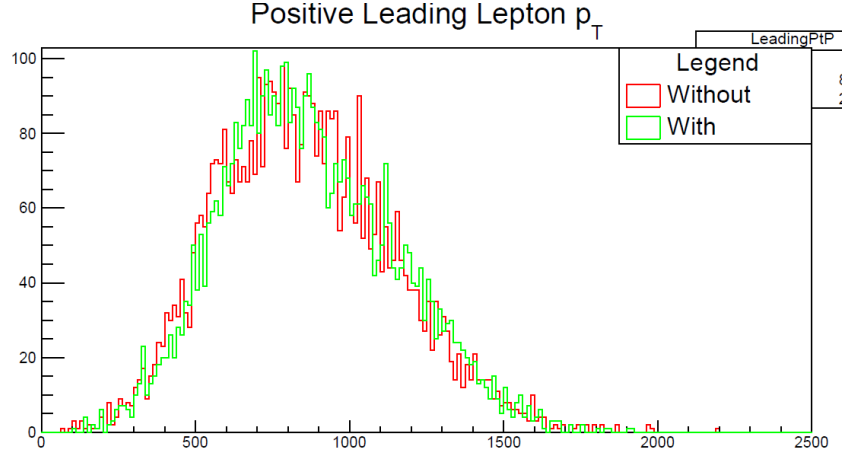






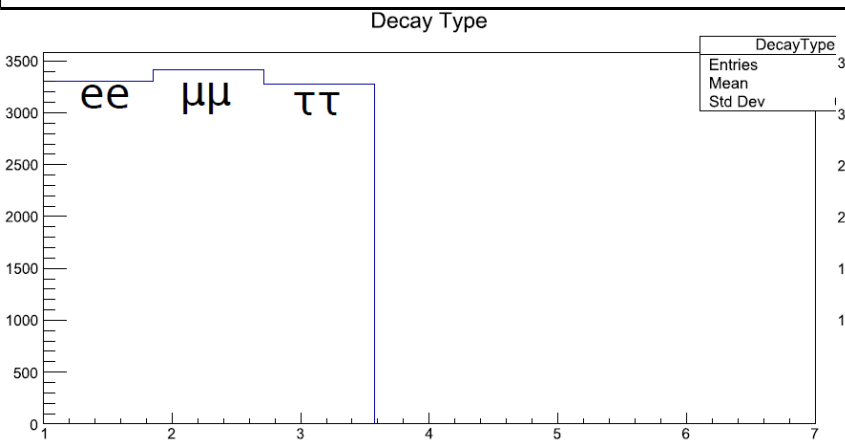


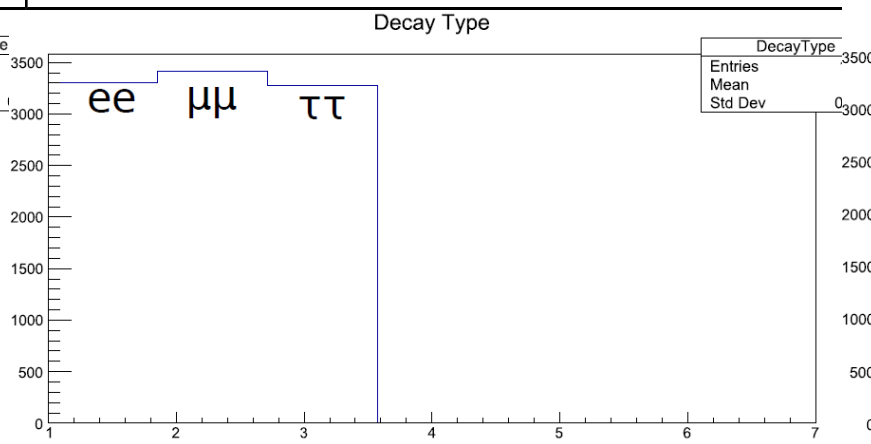


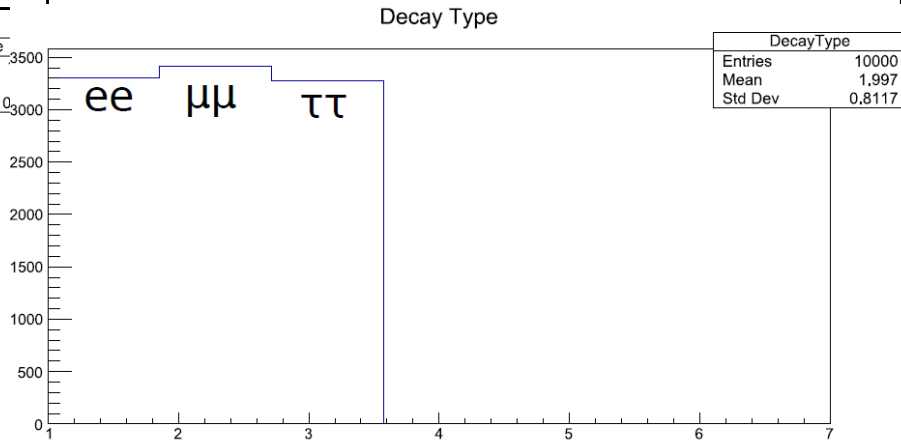


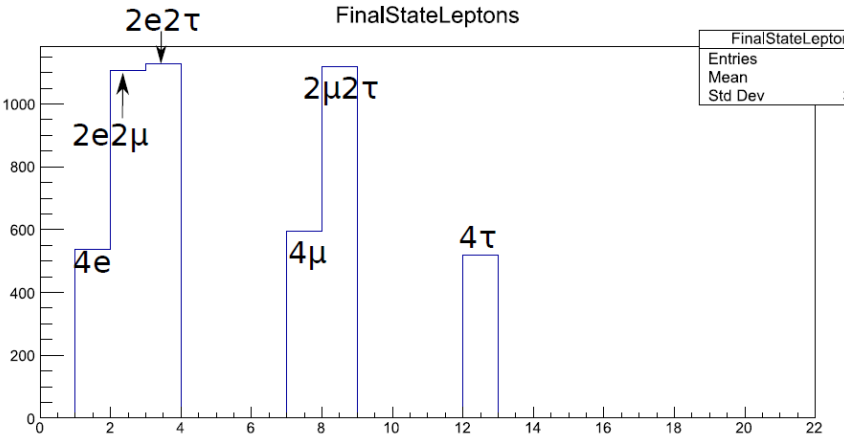
Decay Type and Leptons in the Final State

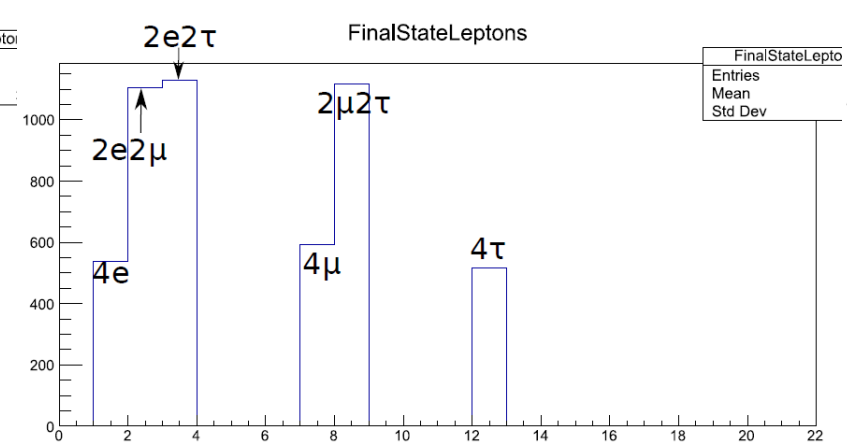
770 GeV	870 GeV	970 GeV

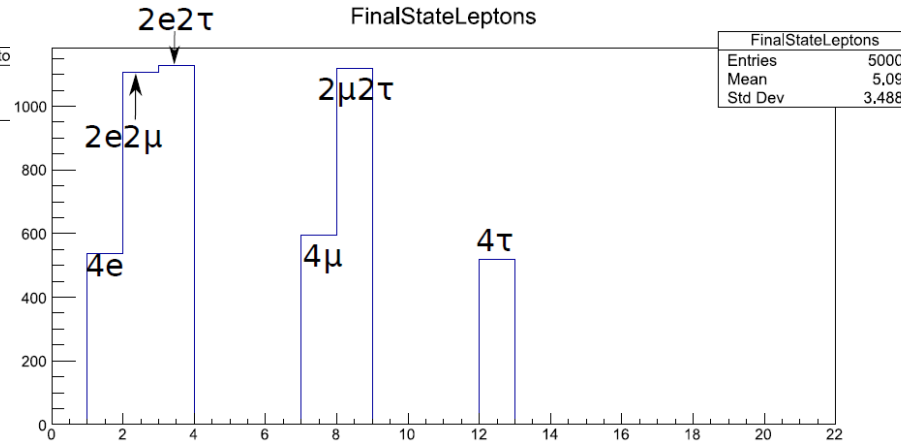






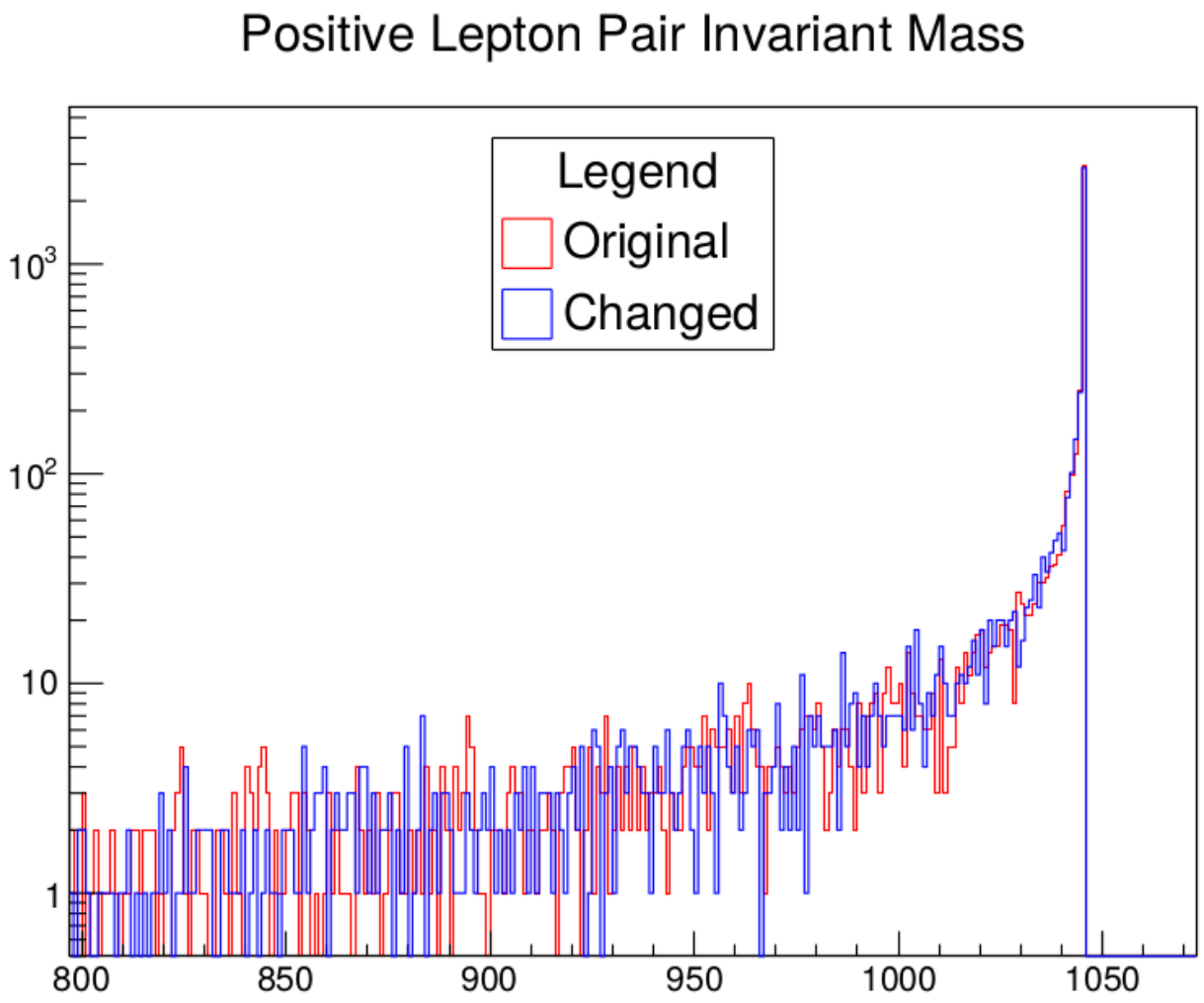


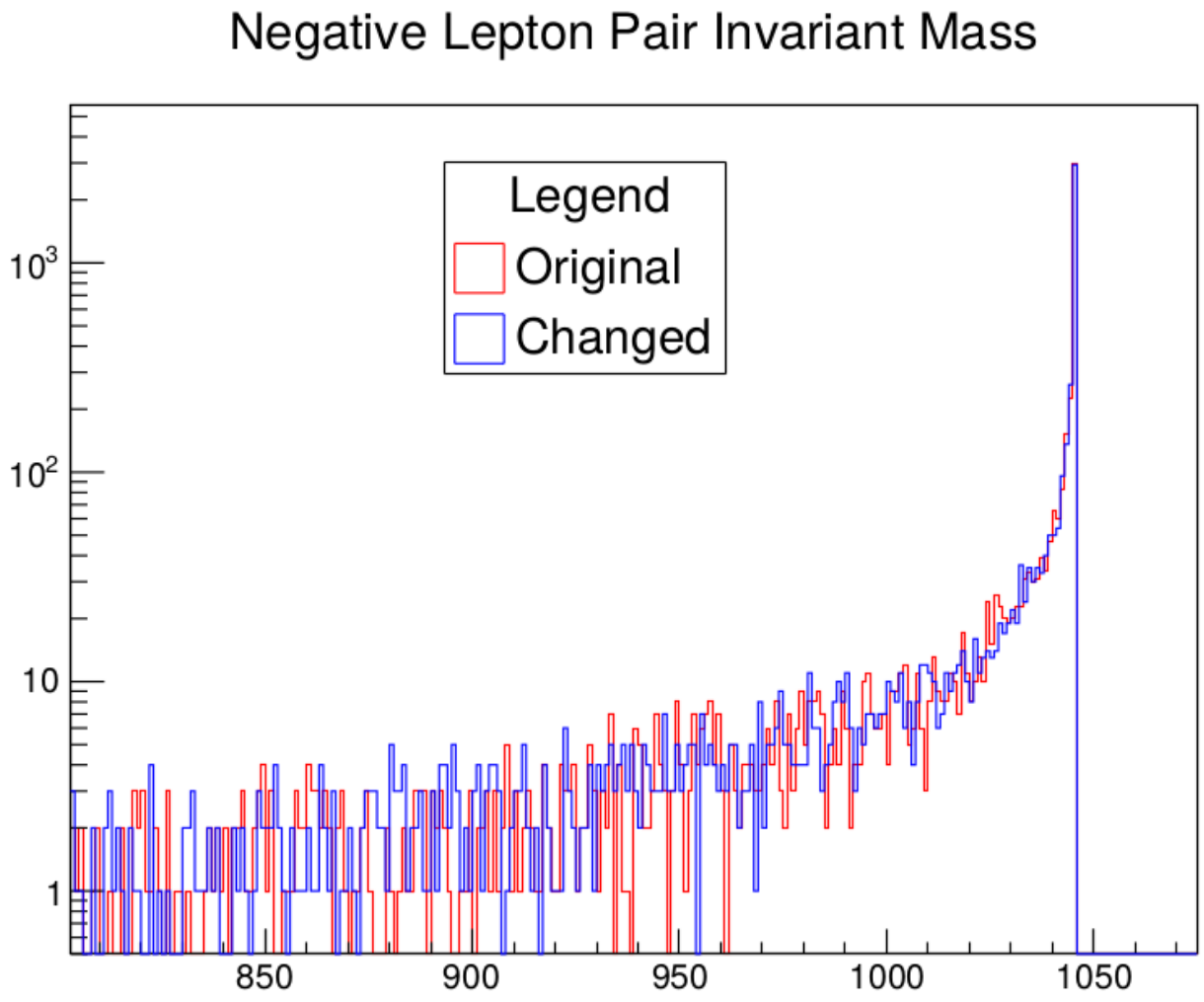




Decay type and leptons in the final state are the same for each mass point and for each Y^{++} mechanismes.

Preliminary test with different masses





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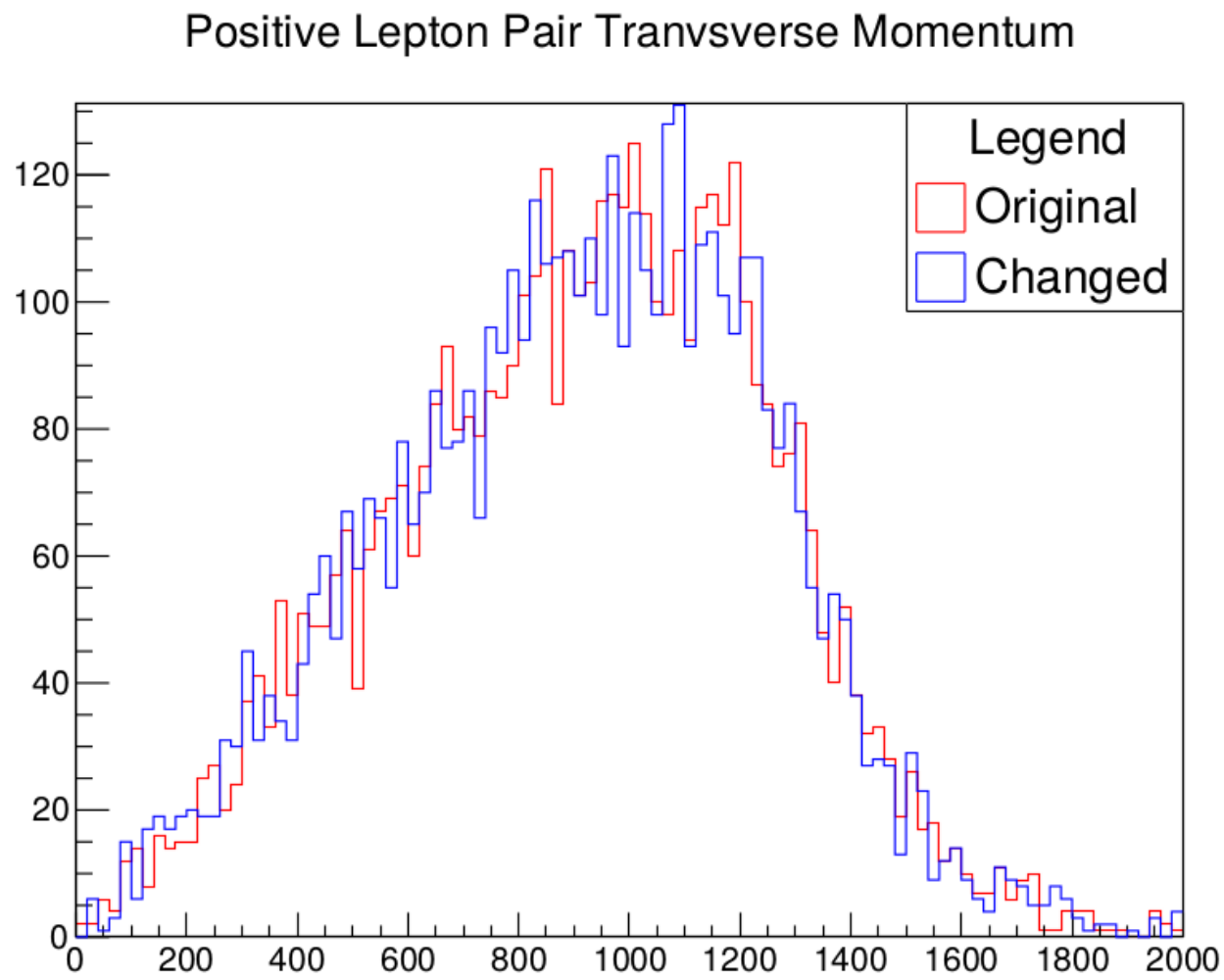

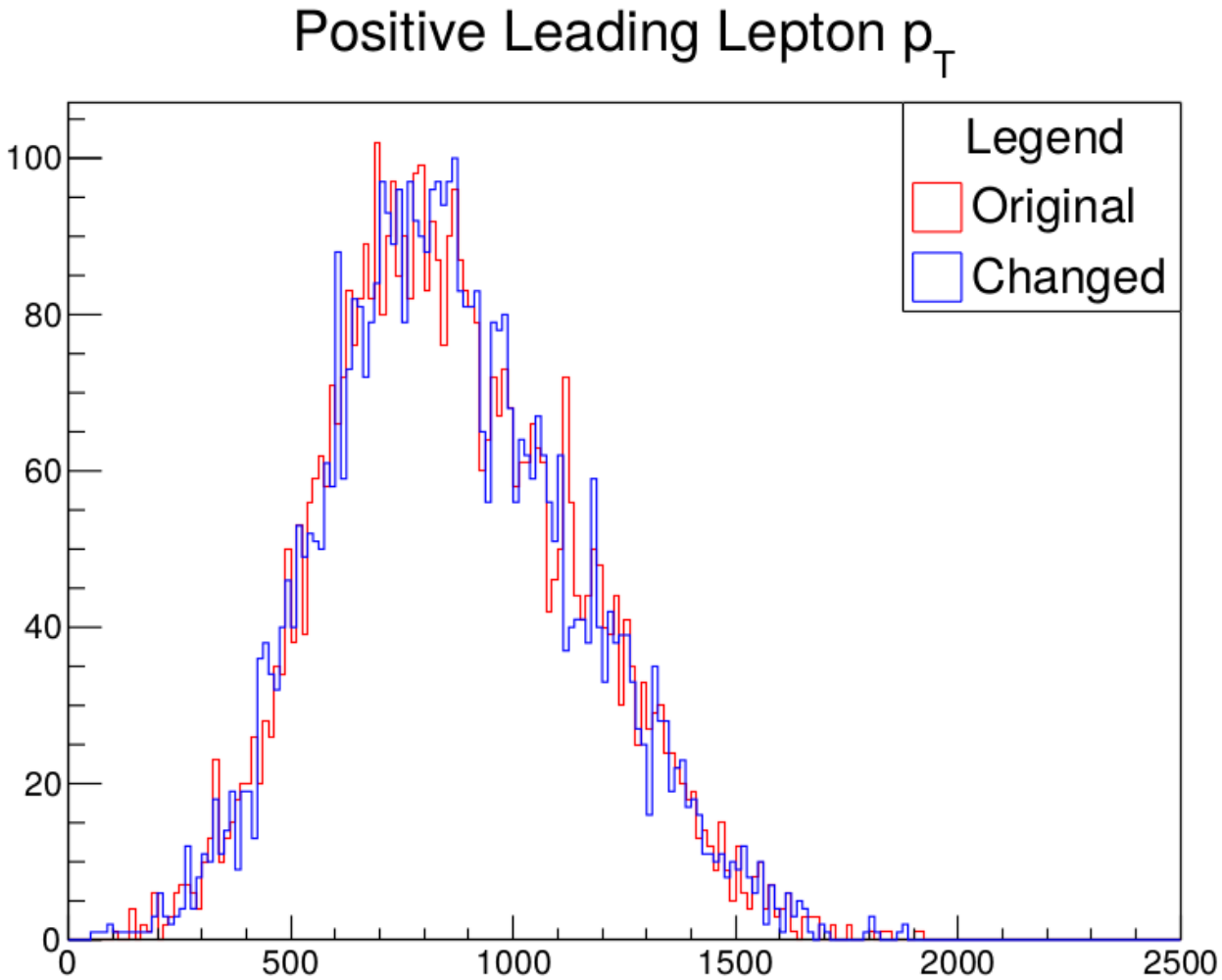

Conclusions

Y^{++} model is validated!

- The region where the masses of Y^{++} and H^{++} are equal is very small.
- Differently from the other productions, for this model is very difficult producing samples with precise mass values (i.e. 800 GeV, 850 GeV, 900 GeV).

What do you think about the ansantz of the $m_{Y++} = m_{H++}$?

If it can be ok, the Y^{++} production can start! Mainly that related to the mechanism without the new coupling introduced.

Thanks for your attention!