



Feasibility Study of Measuring the Higgs Self-coupling Using the Muon Collider

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Old background

- Signal: $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + H + H$ (0.0008182 pb)
- Background:
 - $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + b + \bar{b} + Z$ (0.03183 pb)
 - $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + b + \bar{b} + H$ (0.003771 pb)
 - $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + b + \bar{b} + b + \bar{b}$ (0.0009237 pb)

100k for each



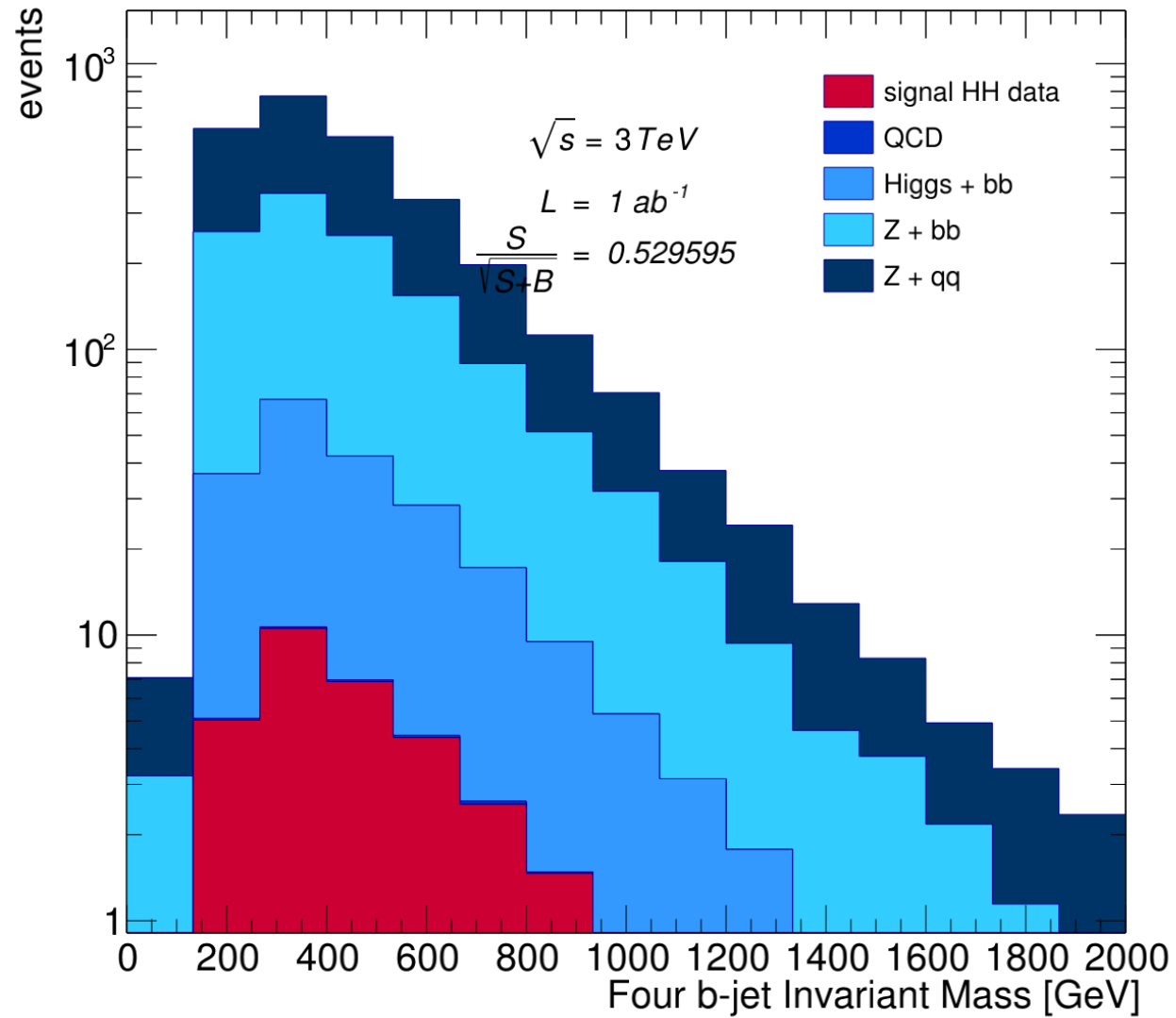
New background

- Signal: $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + H + H$ (0.0008182 pb)
- Background:
 - $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + \mathbf{q} + \bar{\mathbf{q}} + Z$ (0.05685 pb)
 - $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + \mathbf{Z} + \mathbf{Z}$ (**0.081 pb**)
 - $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + b + \bar{b} + H$ (0.003771 pb)
 - $\mu^- + \mu^+ \rightarrow \nu_\mu + \bar{\nu}_\mu + b + \bar{b} + b + \bar{b}$ (0.0009237 pb)

100k for each



Muon Collider Simulation (Delphes)



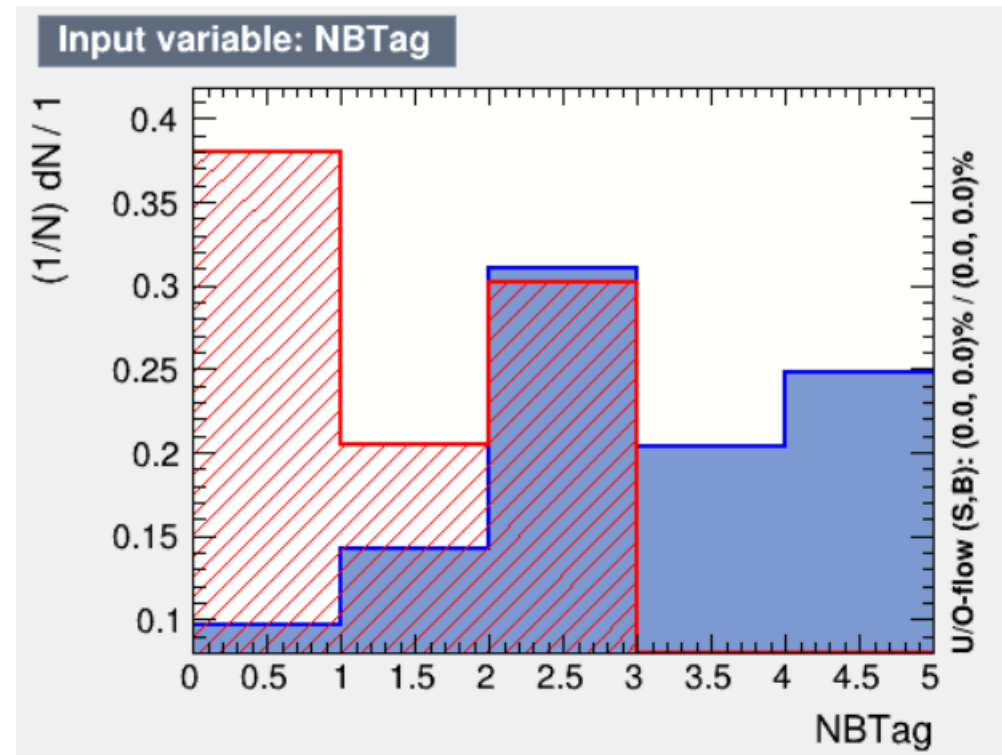
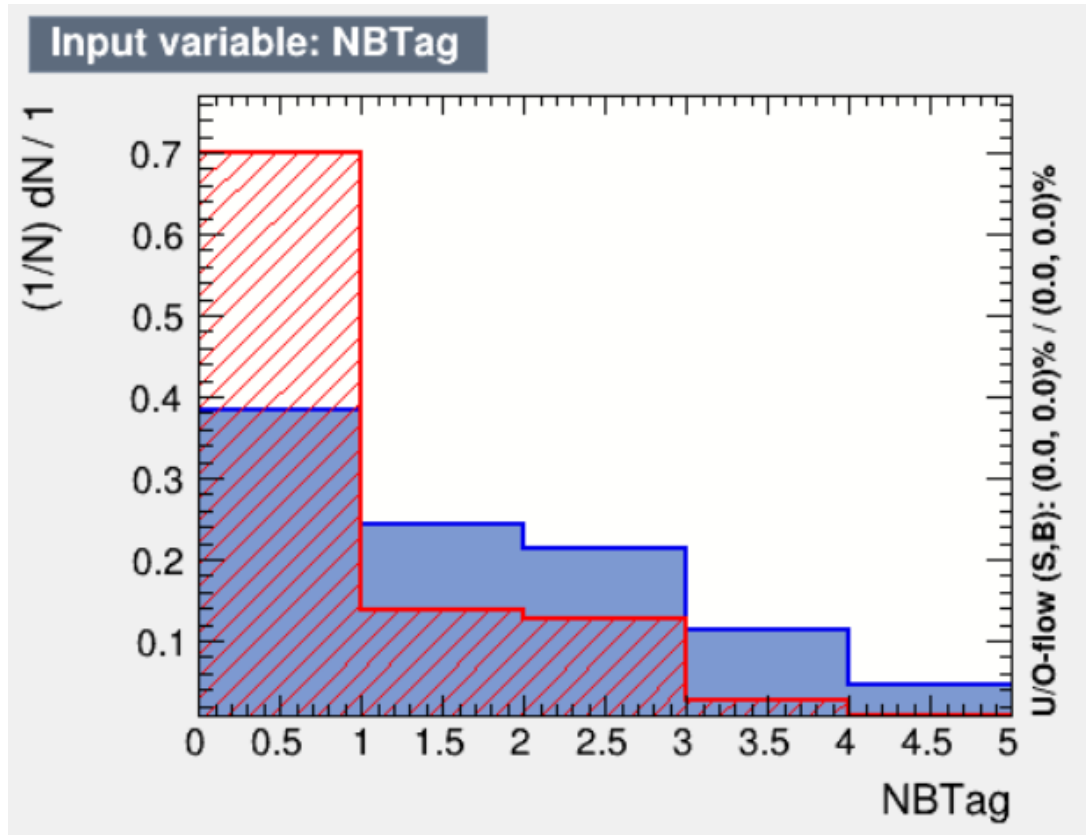


Several changes

- 1. Add an requirement that $m_{HH} > 150$
- 2. use $vvqqz$ instead of $vvbbz$
- 3. add ZZ background



Loose v.s. tight



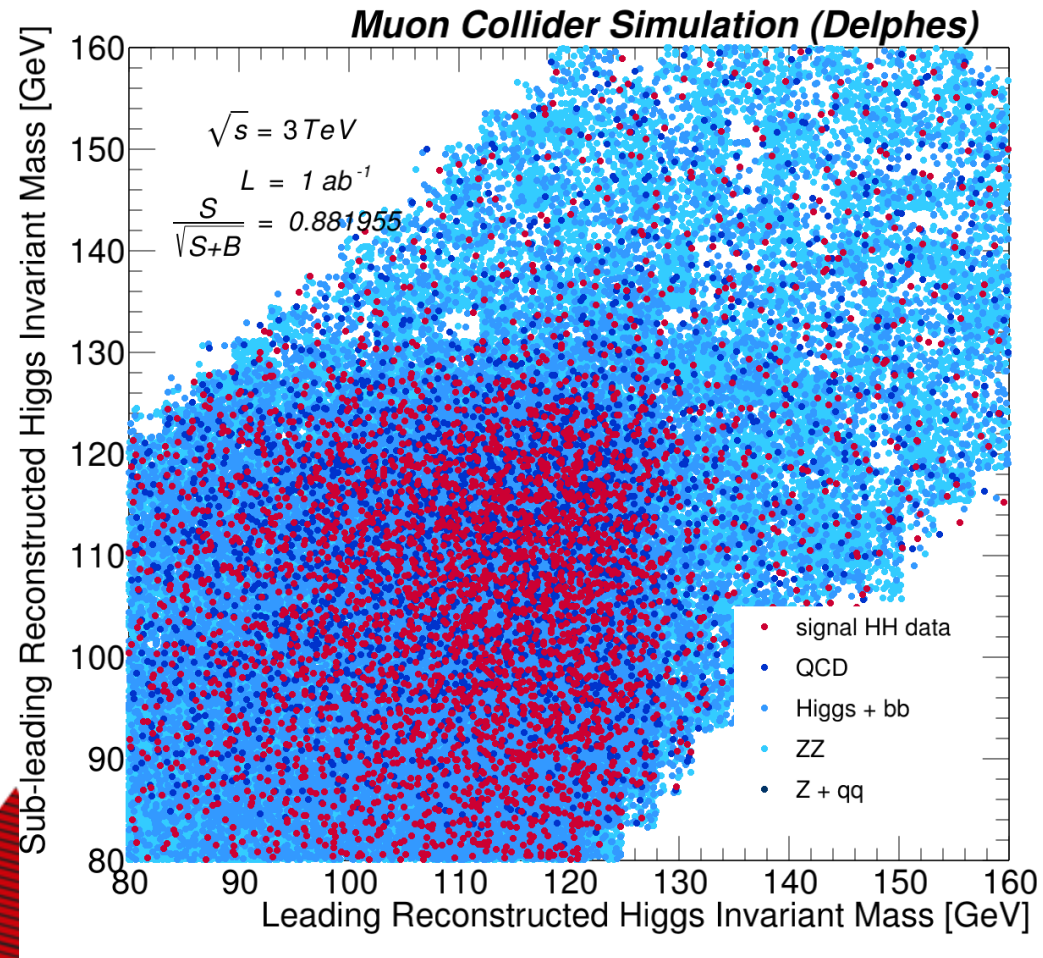


Using tight B-tagging

	Signal Strength	ROC
Btag \geq 2	0.820	0.879
Btag \geq 3	0.882	0.873
Btag=4	0.754	0.887



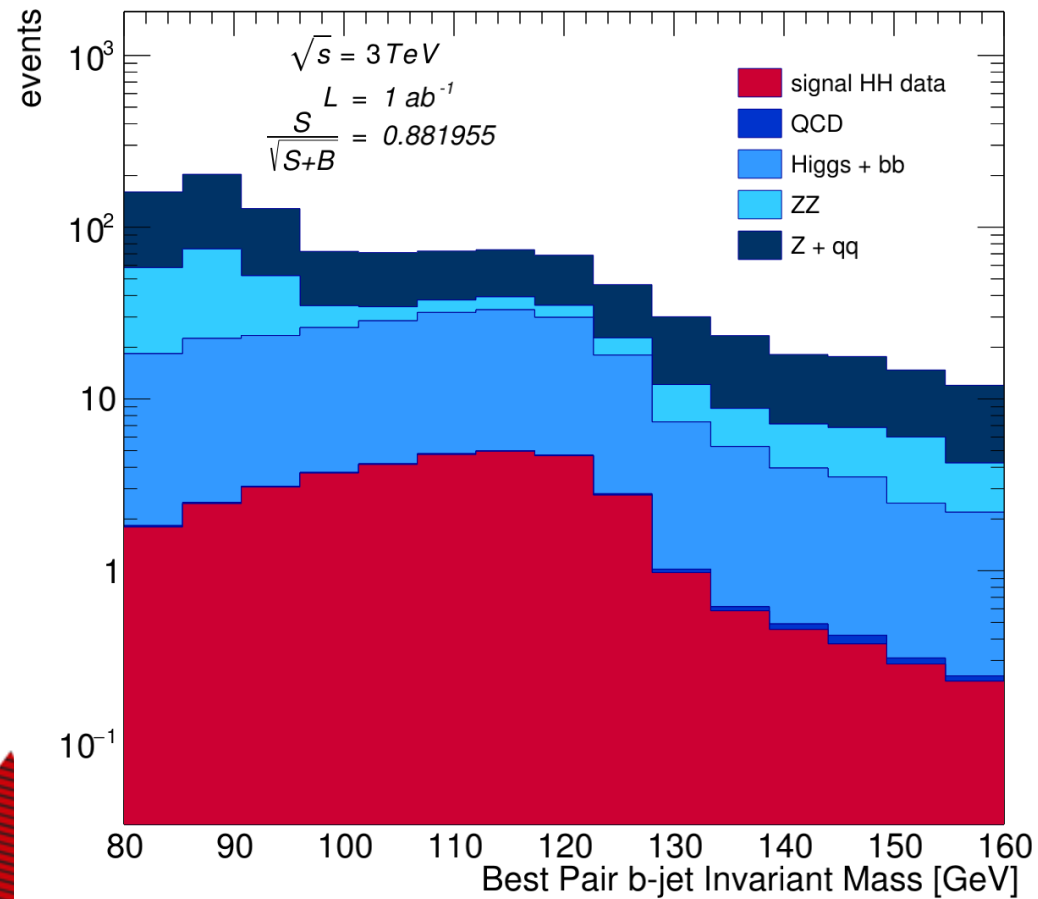
Requiring 3 tight B-Tag





Requiring 3 tight B-Tag

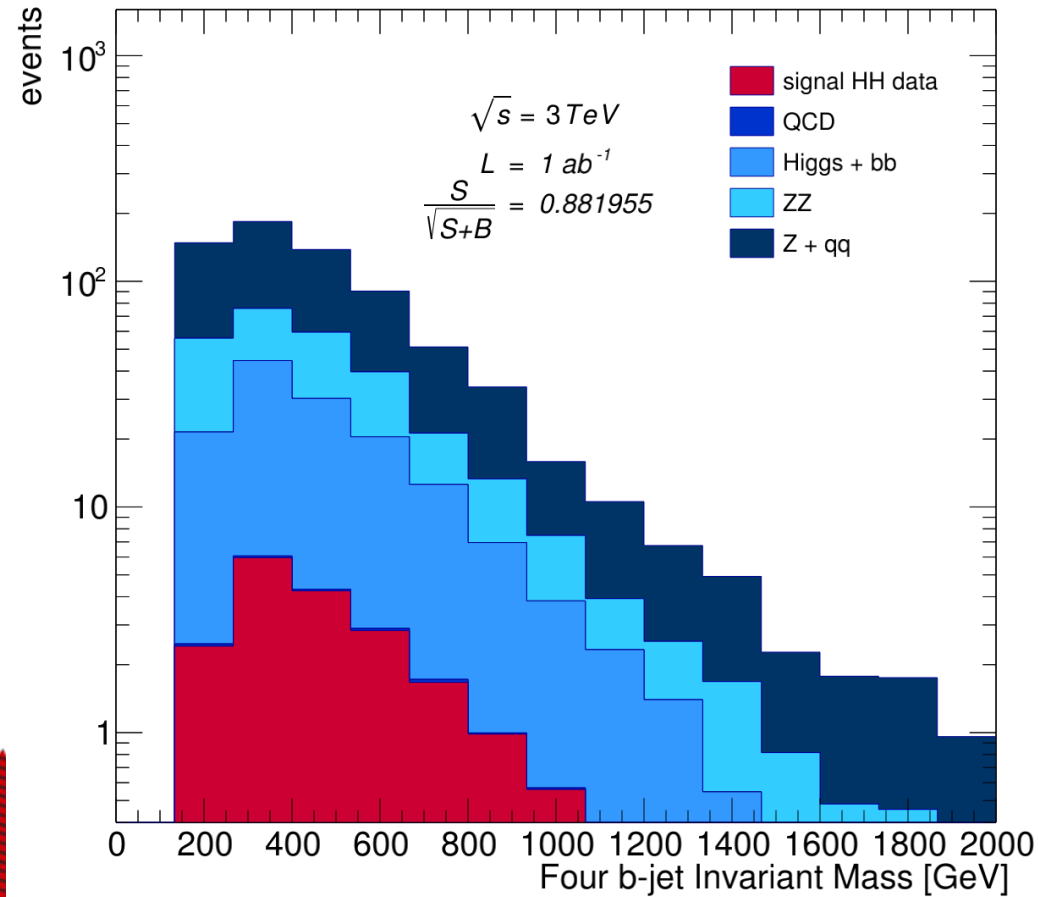
Muon Collider Simulation (Delphes)





Requiring 3 tight B-Tag

Muon Collider Simulation (Delphes)





Next weeks

- 1. cut on $m_H > 90$ or maybe even $m_H < 135$
- 2. 10 TeV data (do we also need 6 TeV and 30 TeV?)

Points shown in **RED** to be included into the Snowmass Summary plots/tables. Additional points (in black) are optional, but can be used to demonstrate performance in the presence of realistic beam background conditions.

COM Energy	125 GeV	1.5 TeV	3 TeV	6 TeV	10 TeV	14 TeV	30 TeV
Total Luminosity (ab-1)	0.020	0.25	1.0	4.0	10	10	10