

# Holistic analysis for Hss

## Hao LIANG

### LLR

# Holistic

- No window cut/BDT based event selection with kinematics
- No Flavor tagging/JOI
- End-End

# Sample

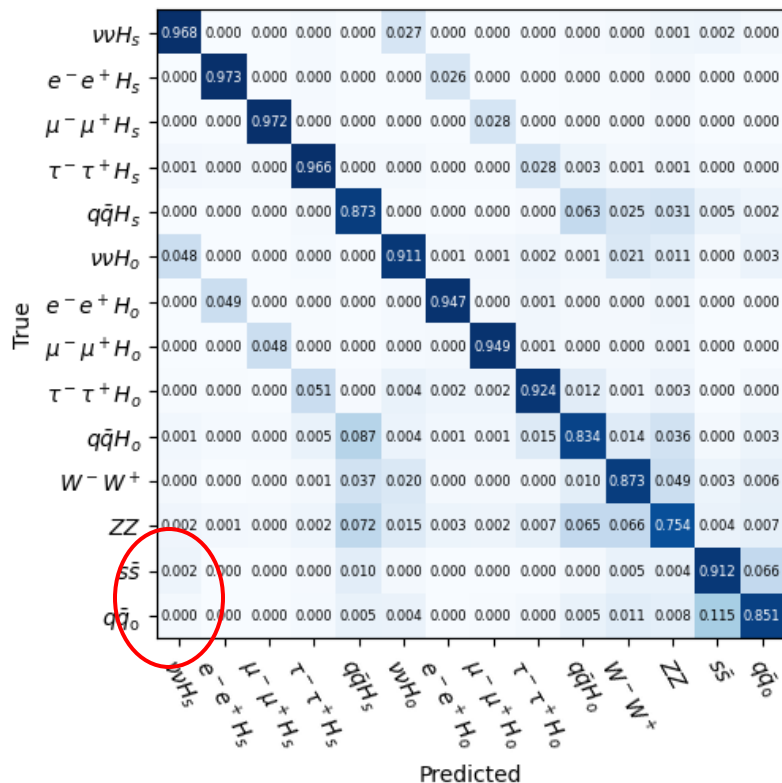
## whizard1.95 + pythia6

## FastSimulationProcessor

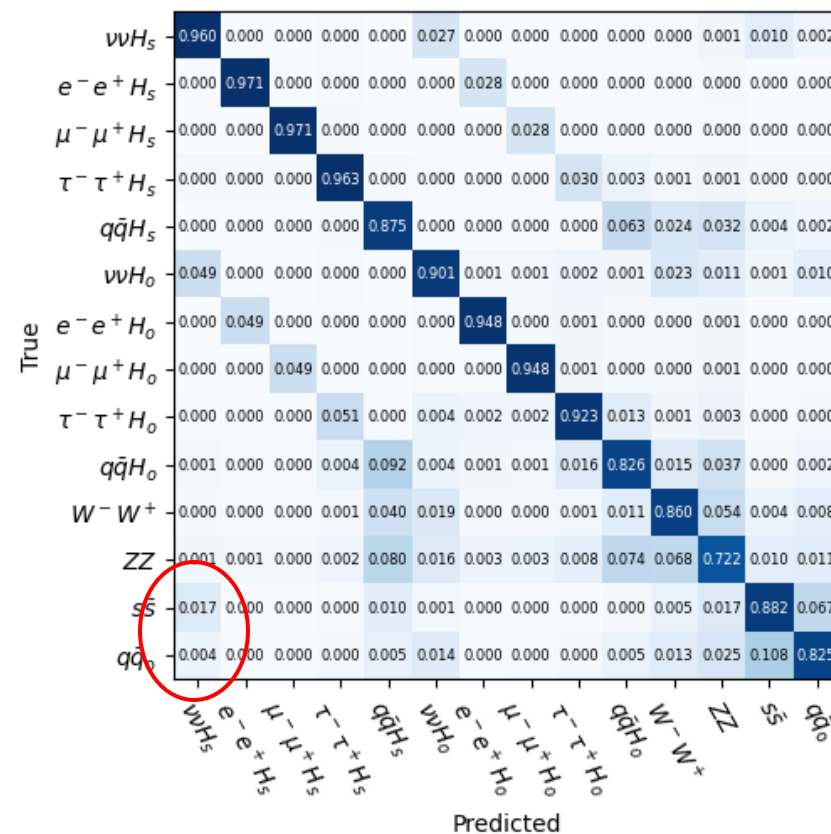
|              | train | test |                                   |  |
|--------------|-------|------|-----------------------------------|--|
| 2f           | 1M    | 9M   |                                   |  |
| WW           | 1M    | 9M   | No interference with ZZ, on shell |  |
| ZZ           | 1M    | 9M   | No interference with WW, on shell |  |
| llH,H->ss    | 1M    | 1M   | Including tau tau H               |  |
| llH,H->other | 1M    | 1M   | Including tau tau H               |  |
| vvH, H->ss   | 1M    | 1M   |                                   |  |
| vvH,H->other | 1M    | 1M   |                                   |  |
| qqH,H->ss    | 1M    | 1M   |                                   |  |
| qqH,H->other | 1M    | 1M   |                                   |  |
|              |       |      |                                   |  |

# Confusion matrix

## New

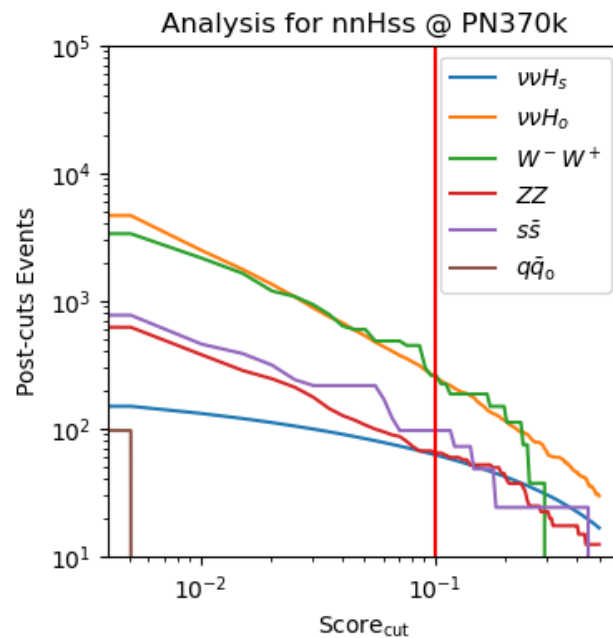
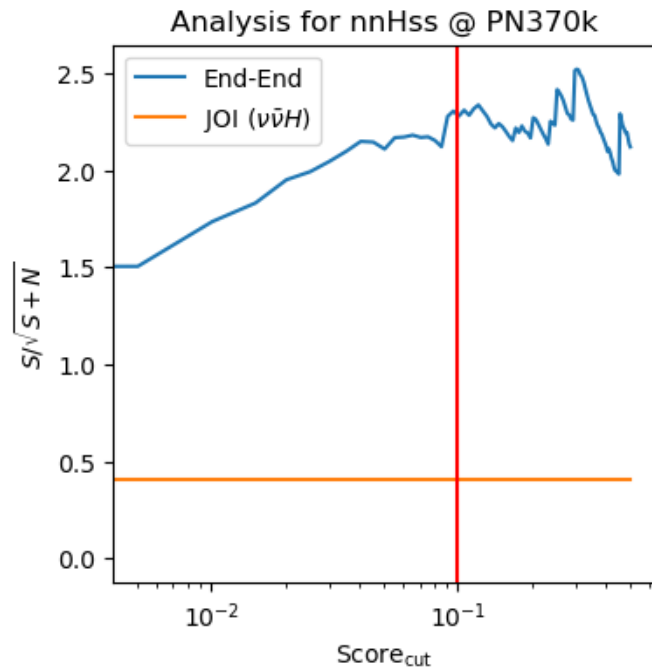


Previous


$$\begin{aligned} \text{vvHs} &= vvH, H \rightarrow ss, \text{vvHo} = \text{vvHother} = vvH, H \rightarrow \text{others(not ss)} \\ qq_o &= qq\text{other} = qq(\text{but not ss}) \end{aligned}$$

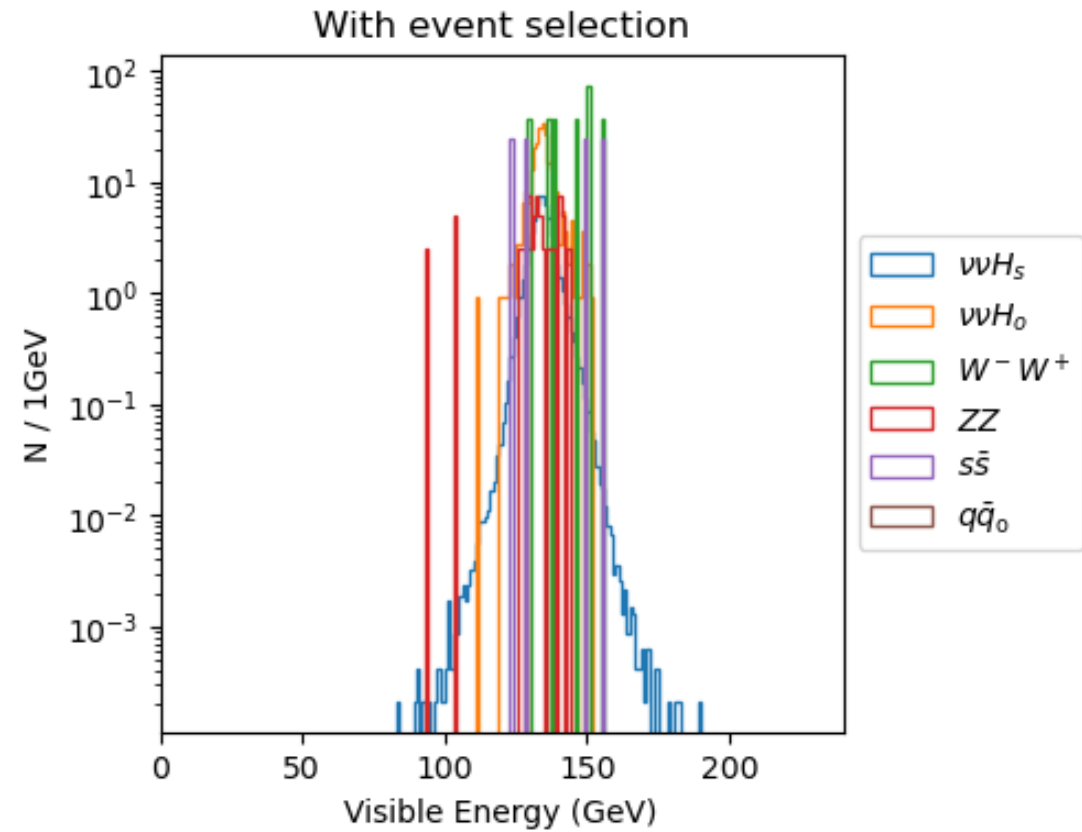
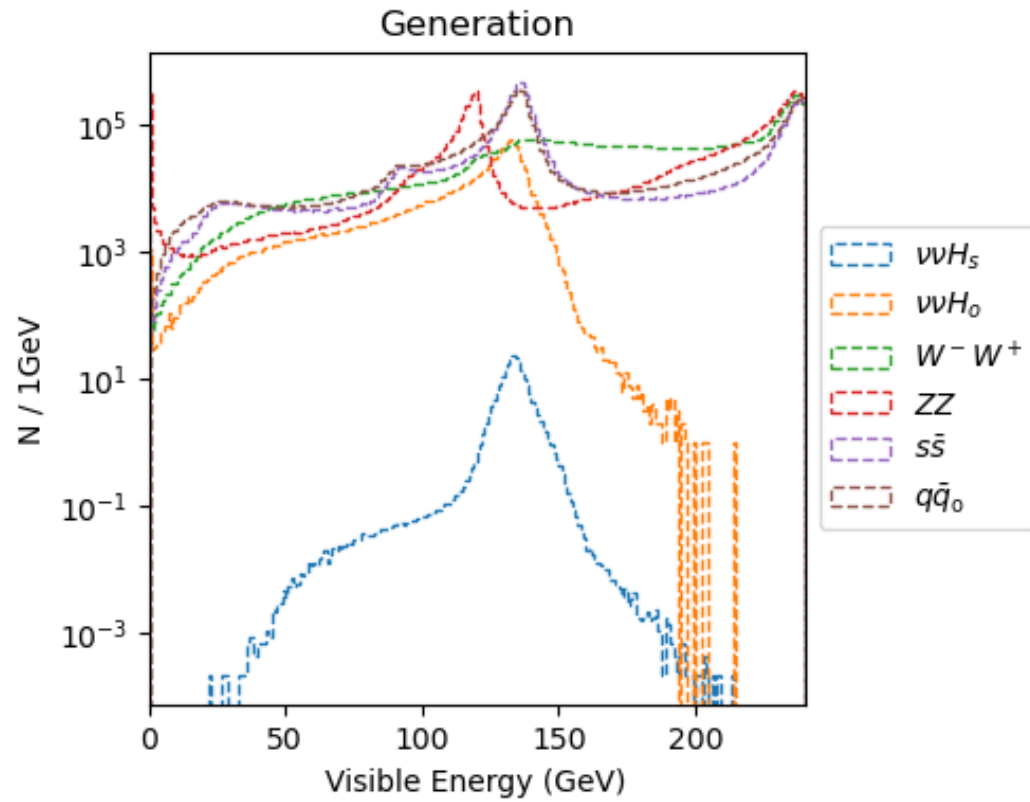
# $\nu\nu H, H \rightarrow ss$ channel

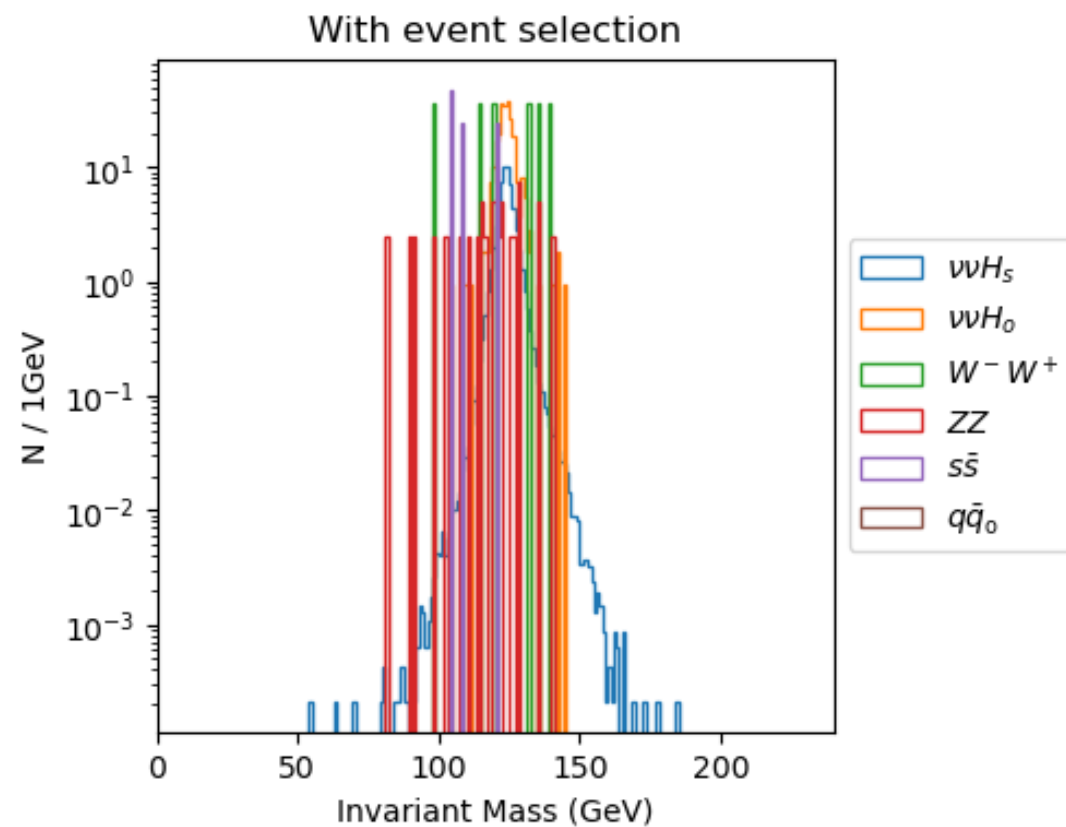
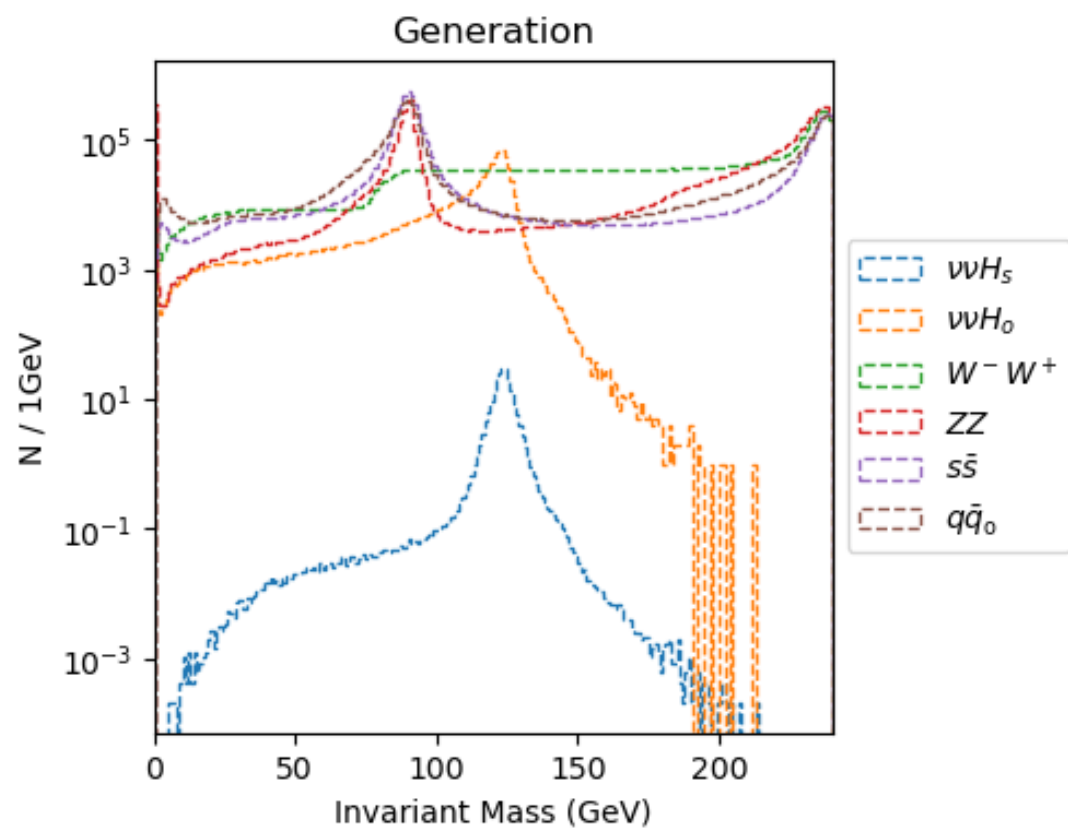
- Main bkg:  $\nu\nu H (H \rightarrow \text{not } ss)$ , not check what Higgs decays into yet!
- Factor of 2 improvement on significance compared to my last holistic

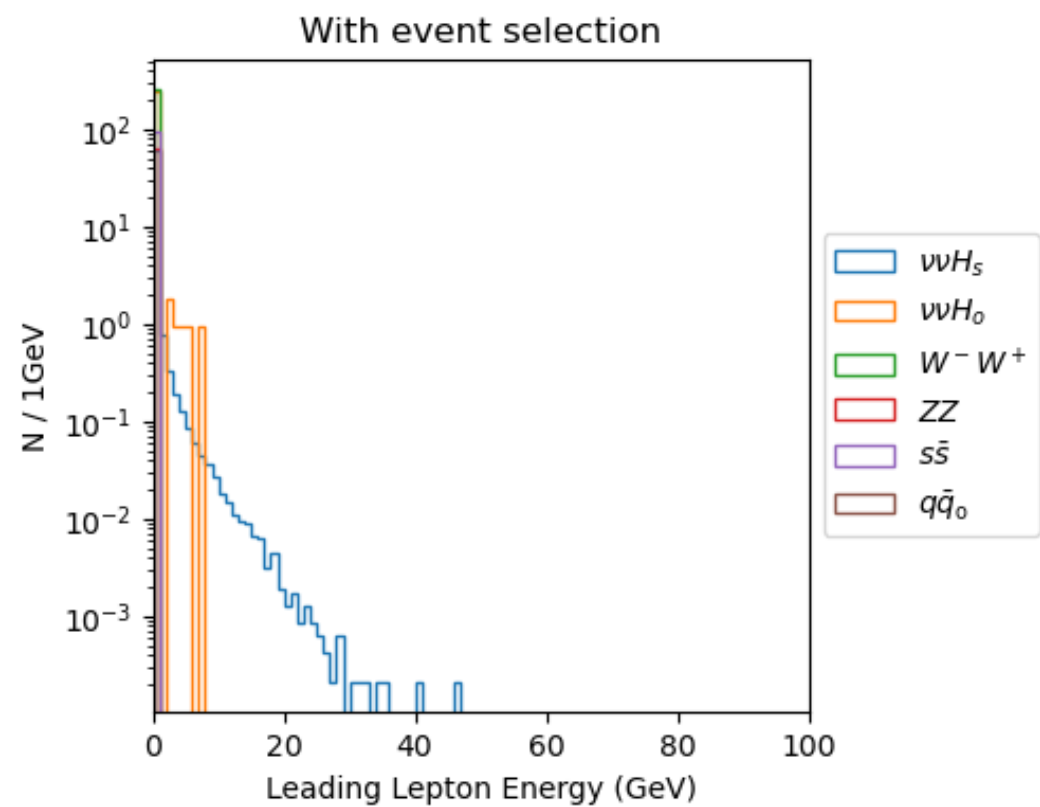
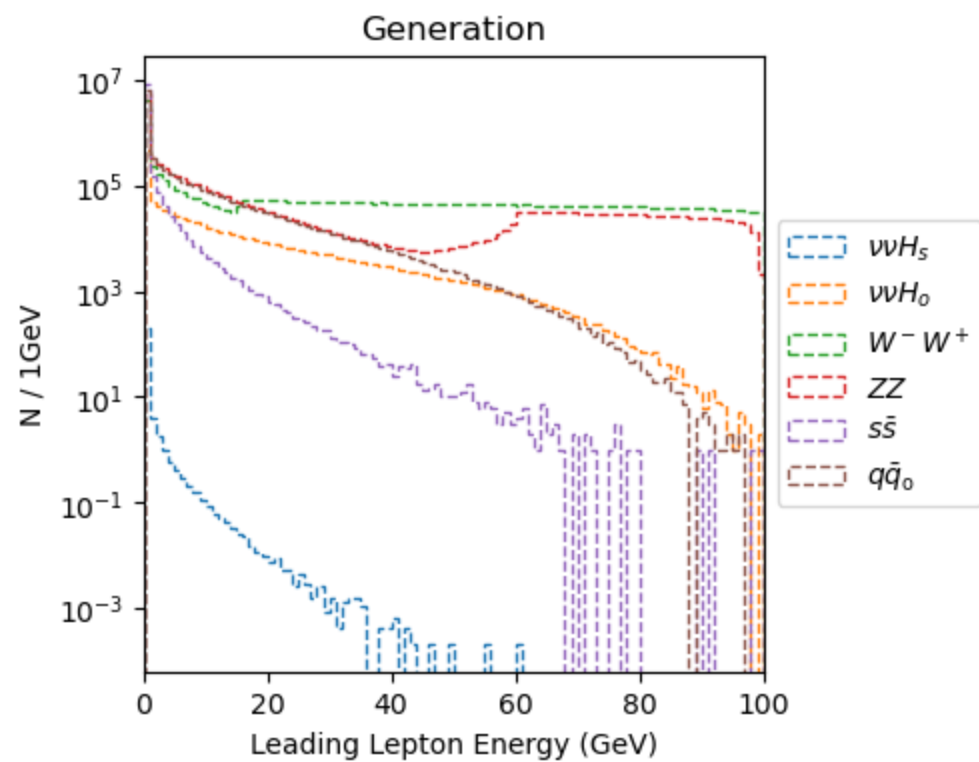


|   | channel  | Events | Monte Carlo Uncertainty | Events (unweighted) |
|---|----------|--------|-------------------------|---------------------|
| 0 | nnHss    | 62     | 0.1150                  | 291520              |
| 1 | nnHother | 253    | 15                      | 273                 |
| 2 | ww       | 260    | 98                      | 7                   |
| 3 | zz       | 64     | 13                      | 26                  |
| 4 | ss       | 96     | 48                      | 4                   |
| 5 | qqother  | 0.0000 | 0.0000                  | 0                   |

# Cut at 0.1

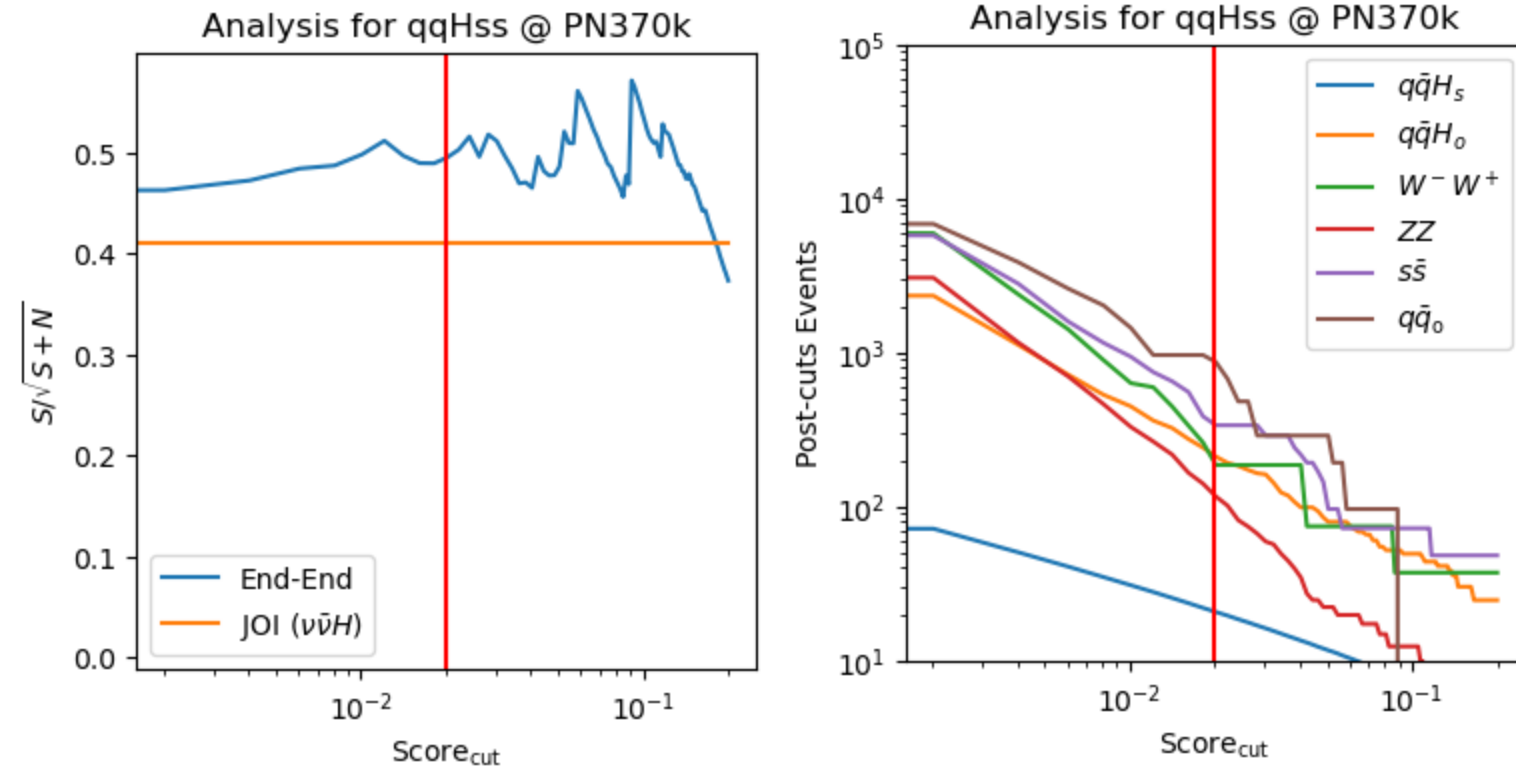






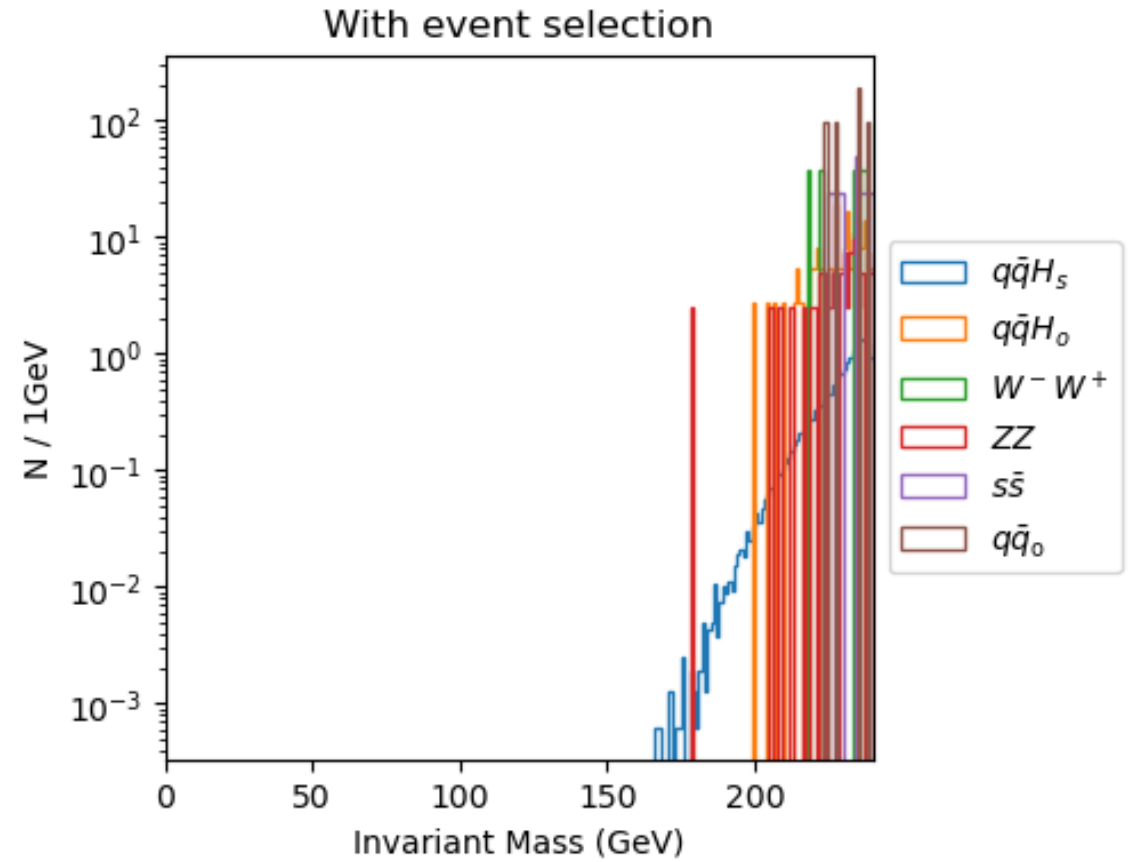
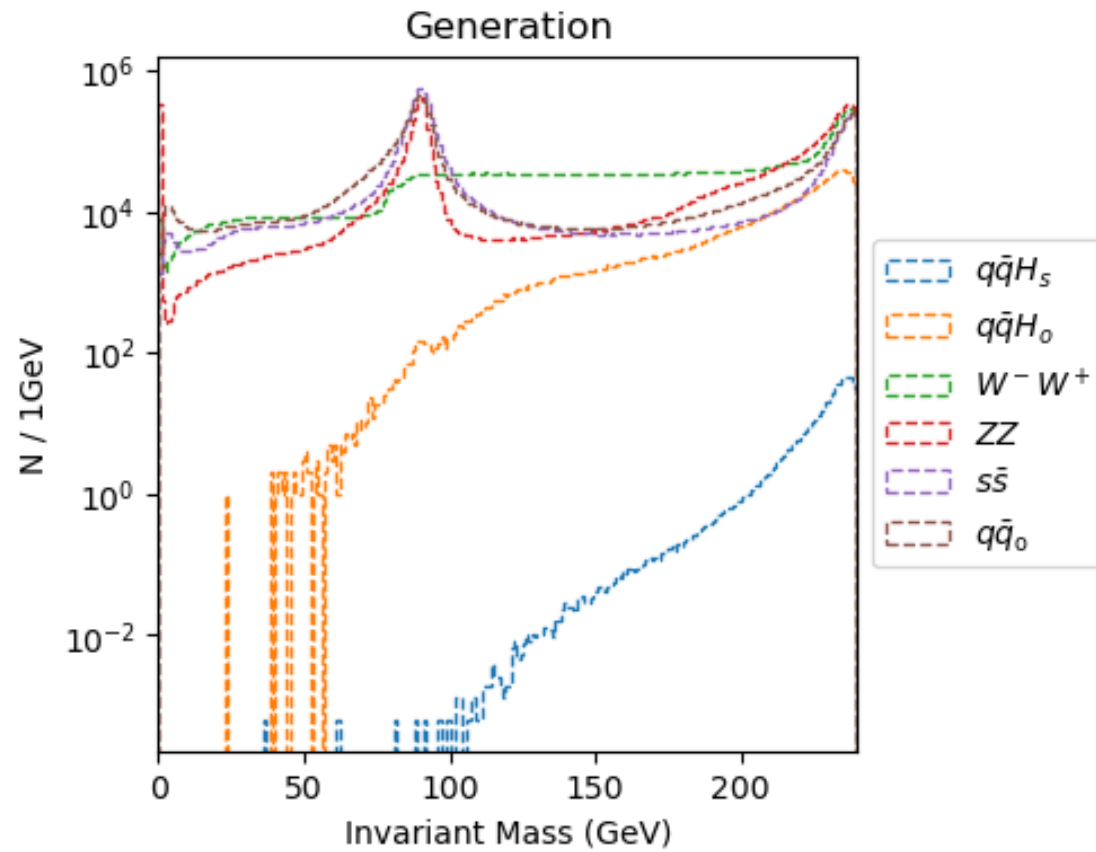
# qqH, H->ss channel

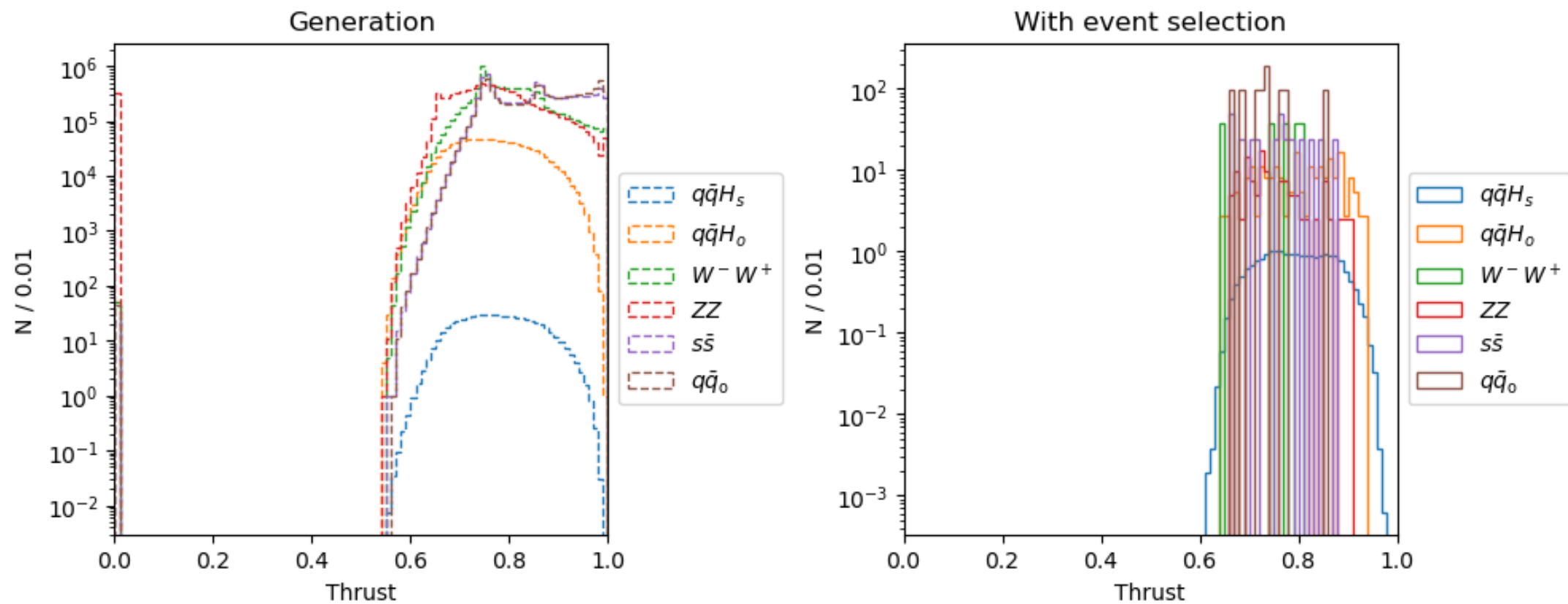
- Main bkg: 2f(ss) and WW, detail not checked yet!

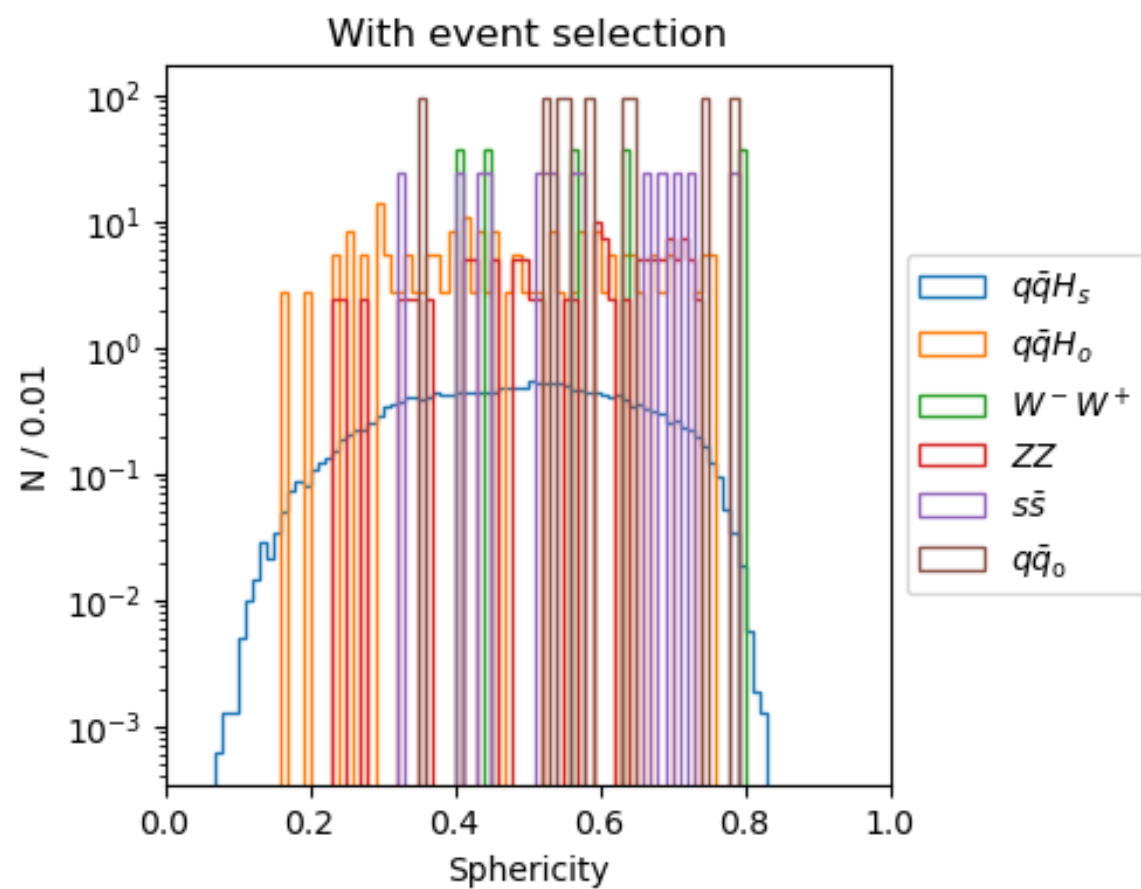
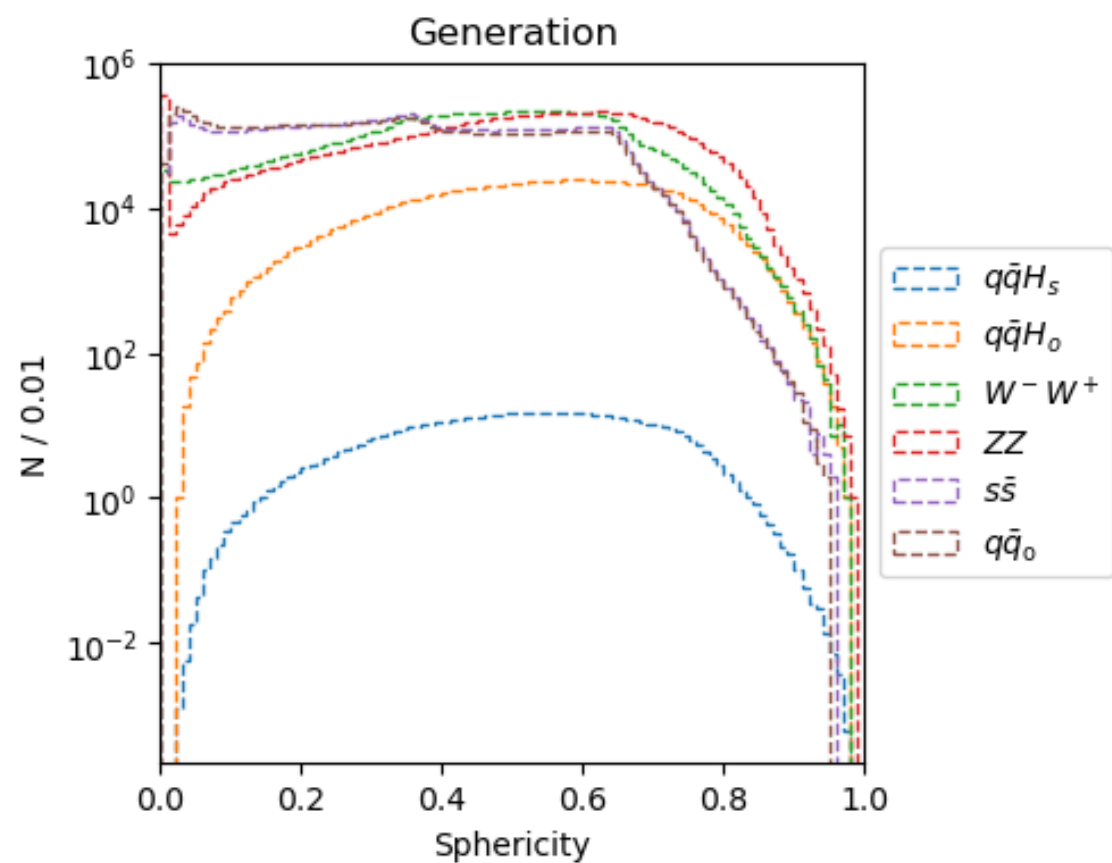


|   | channel  | Events | Monte Carlo Uncertainty | Events (unweighted) |
|---|----------|--------|-------------------------|---------------------|
| 0 | qqHss    | 21     | 0.1143                  | 32987               |
| 1 | qqHother | 211    | 24                      | 77                  |
| 2 | ww       | 186    | 83                      | 5                   |
| 3 | zz       | 121    | 17                      | 49                  |
| 4 | ss       | 337    | 90                      | 14                  |
| 5 | qqother  | 866    | 289                     | 9                   |

# Cut at 0.02

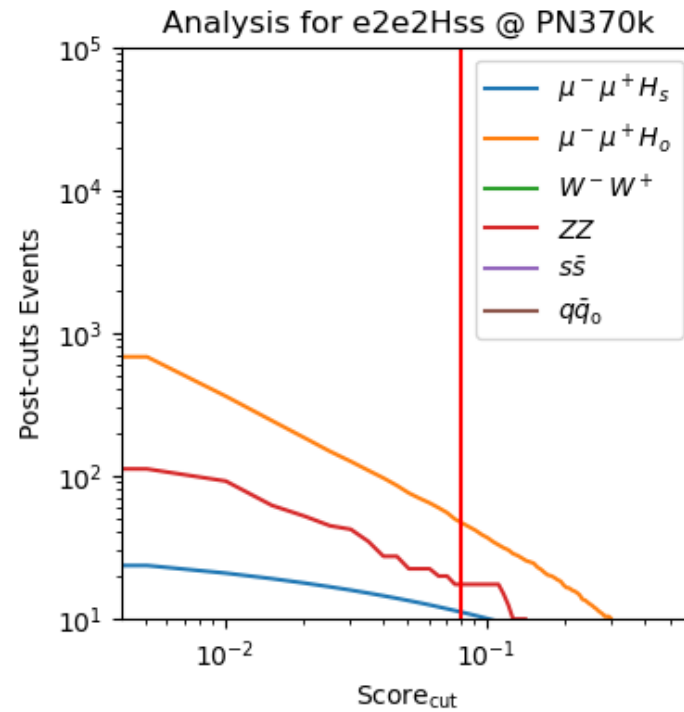
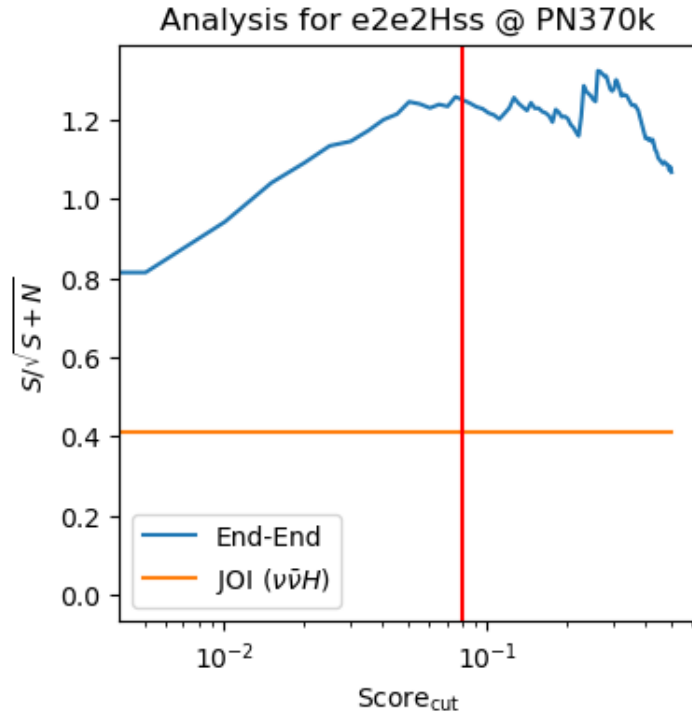






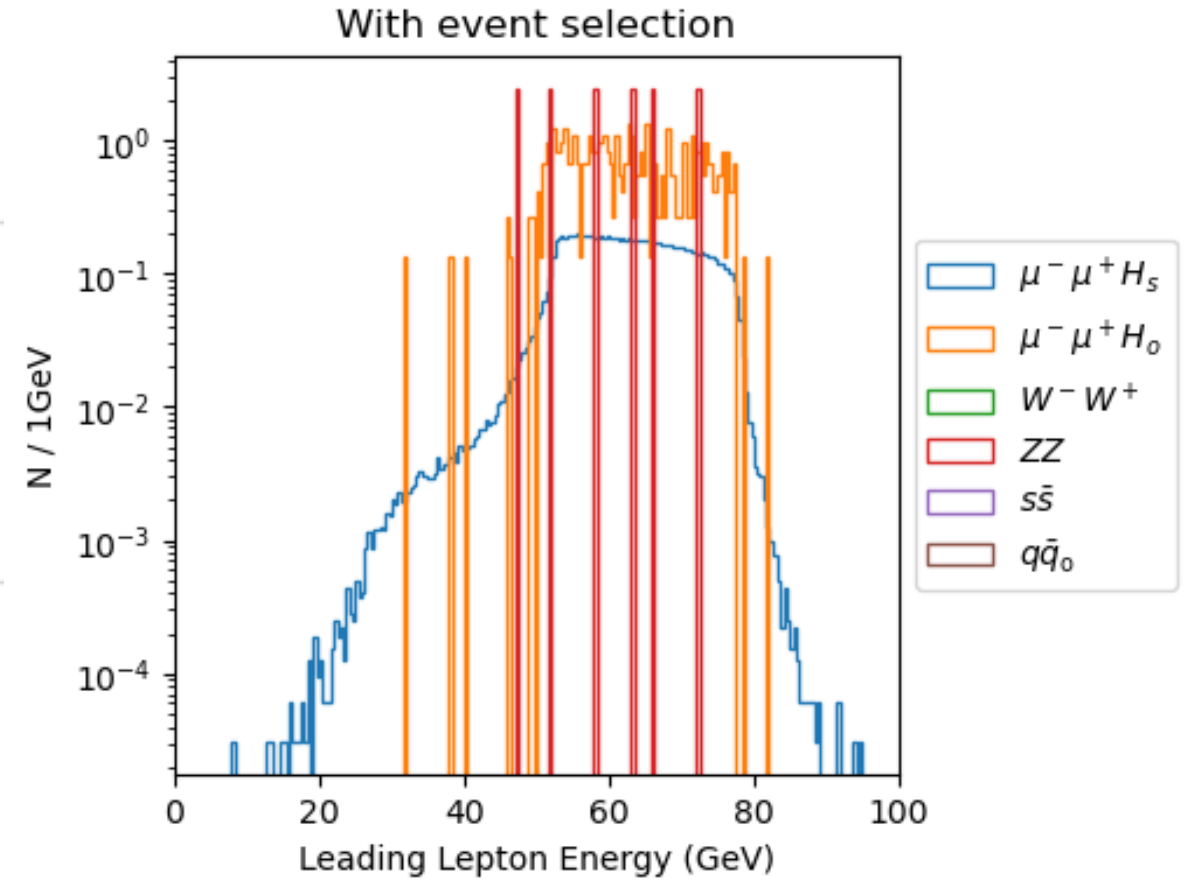
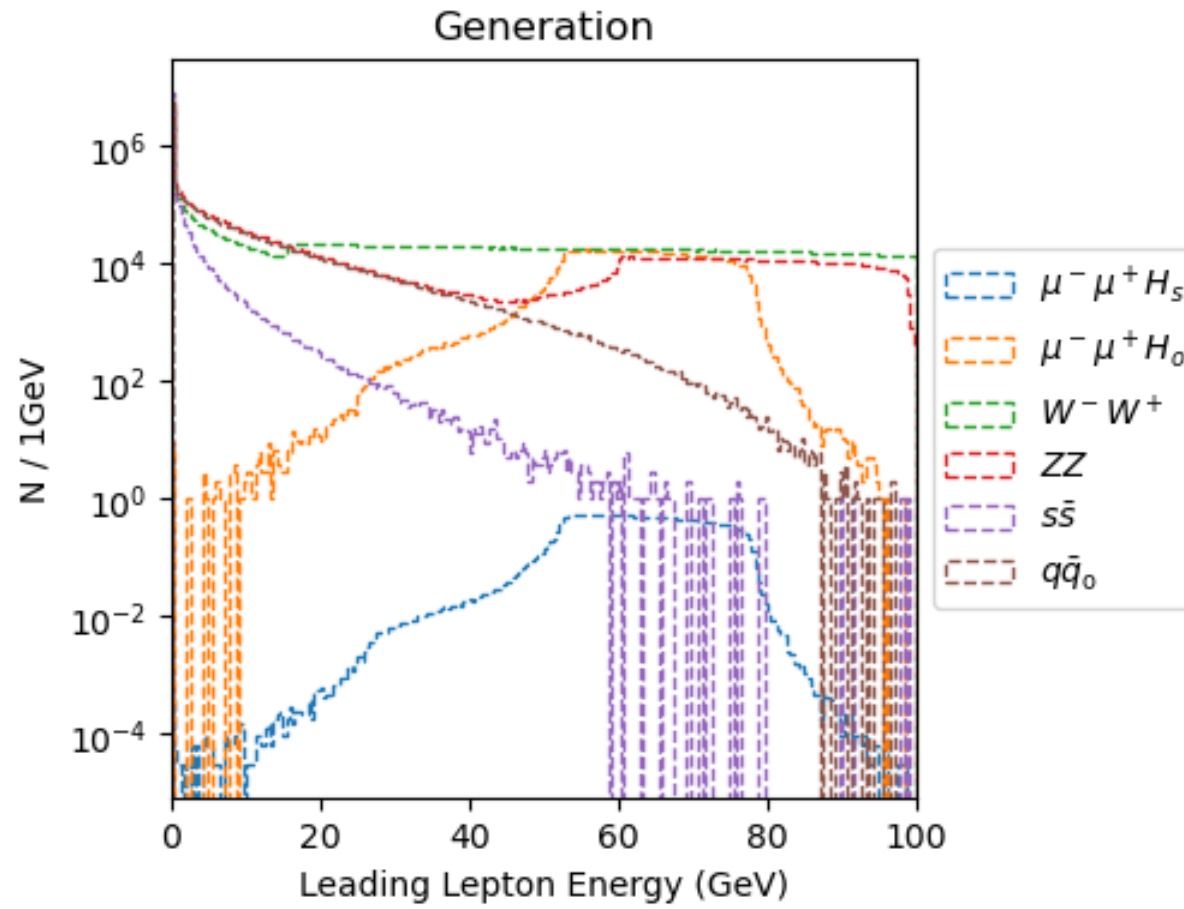
$$\mu\mu H, H \rightarrow ss$$

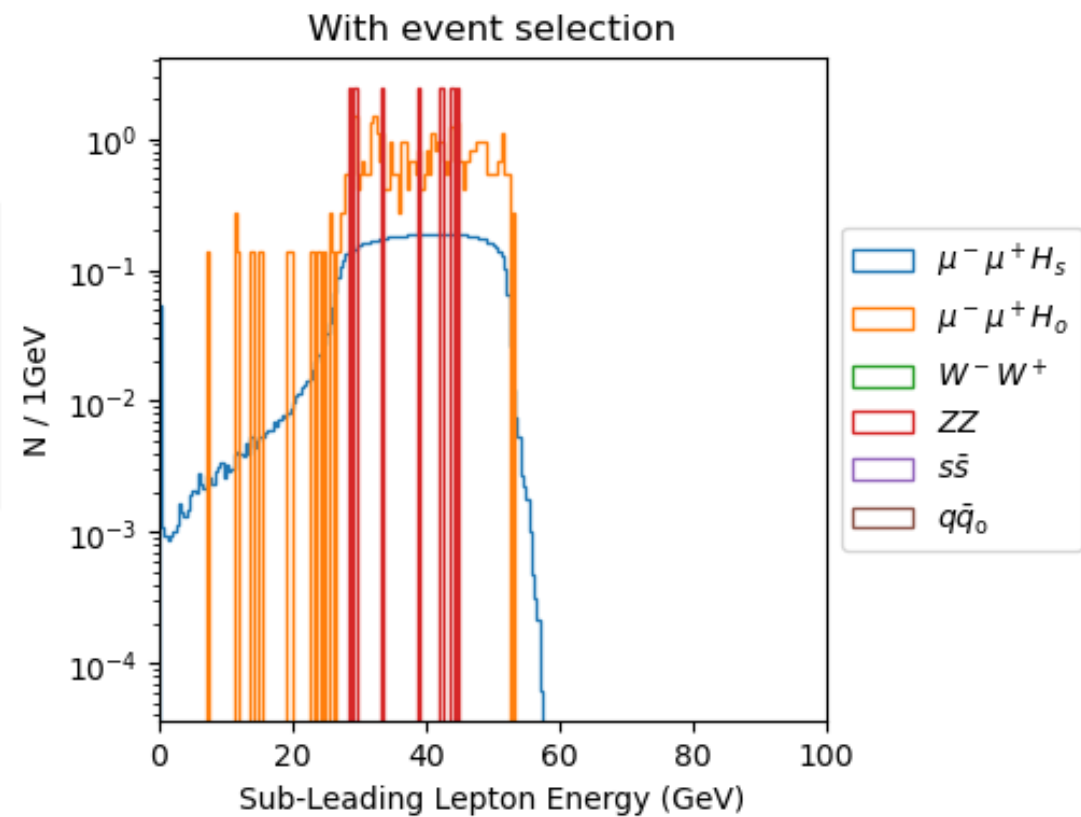
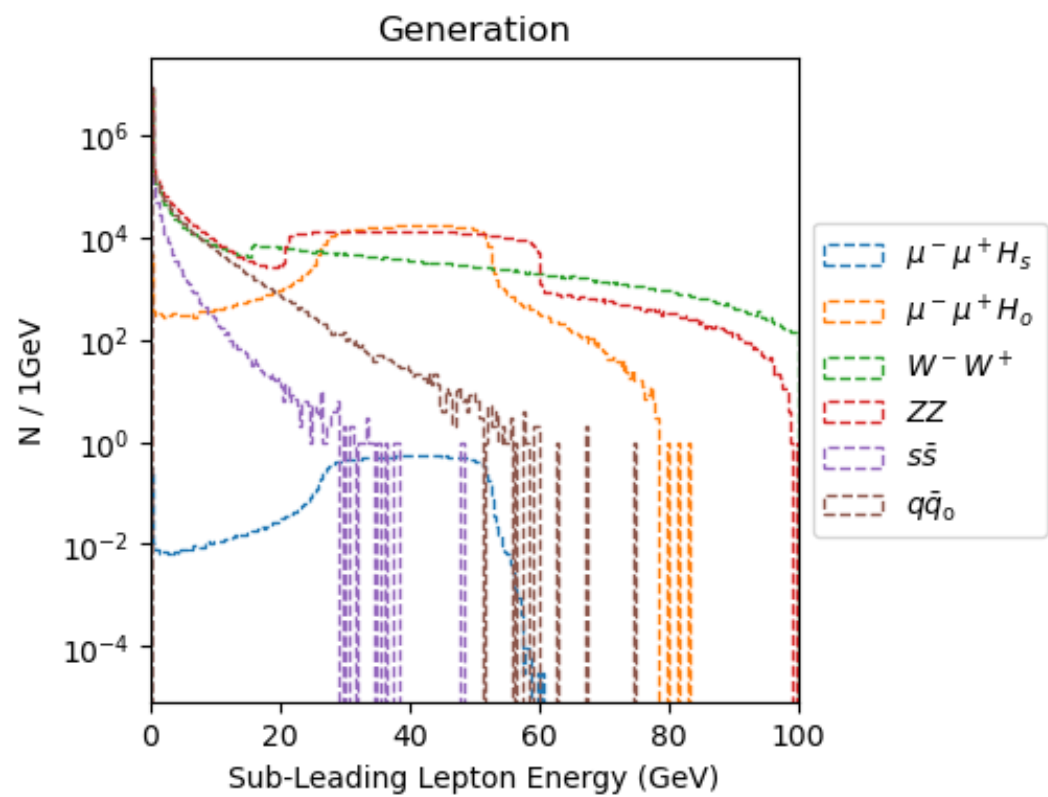
- Very clean!

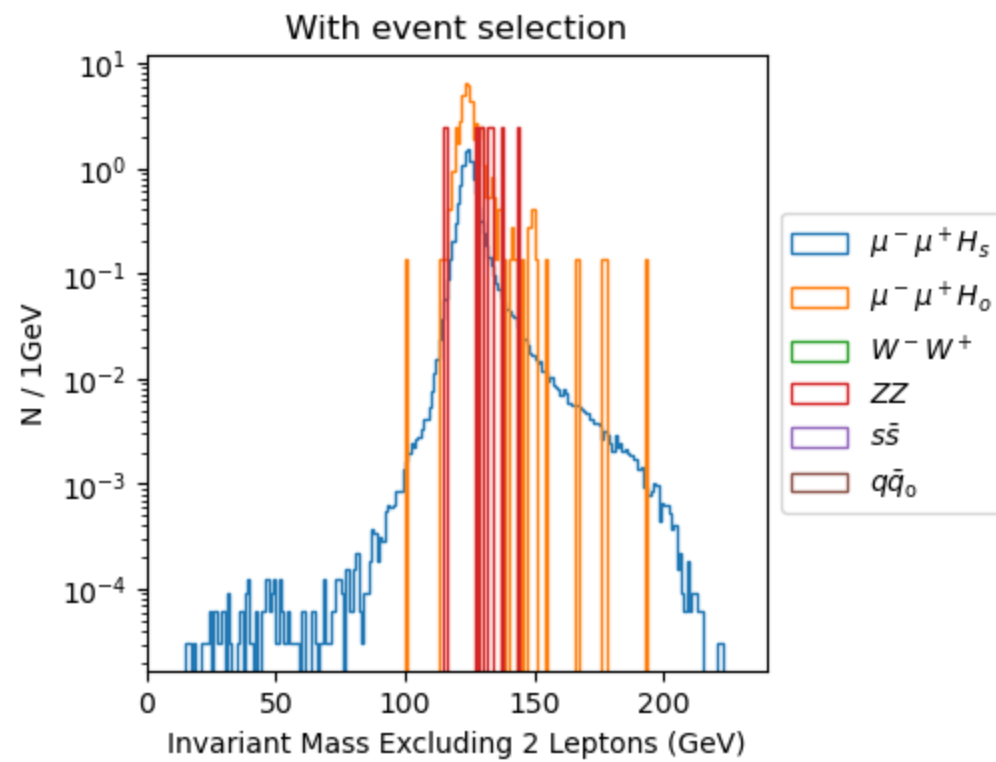
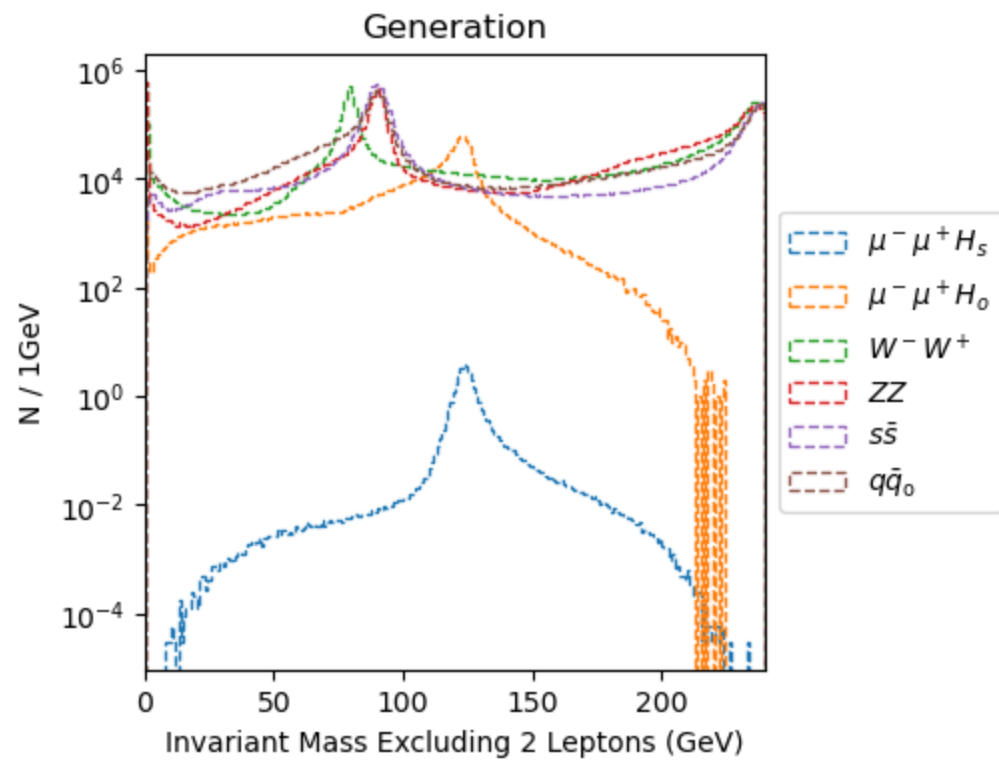


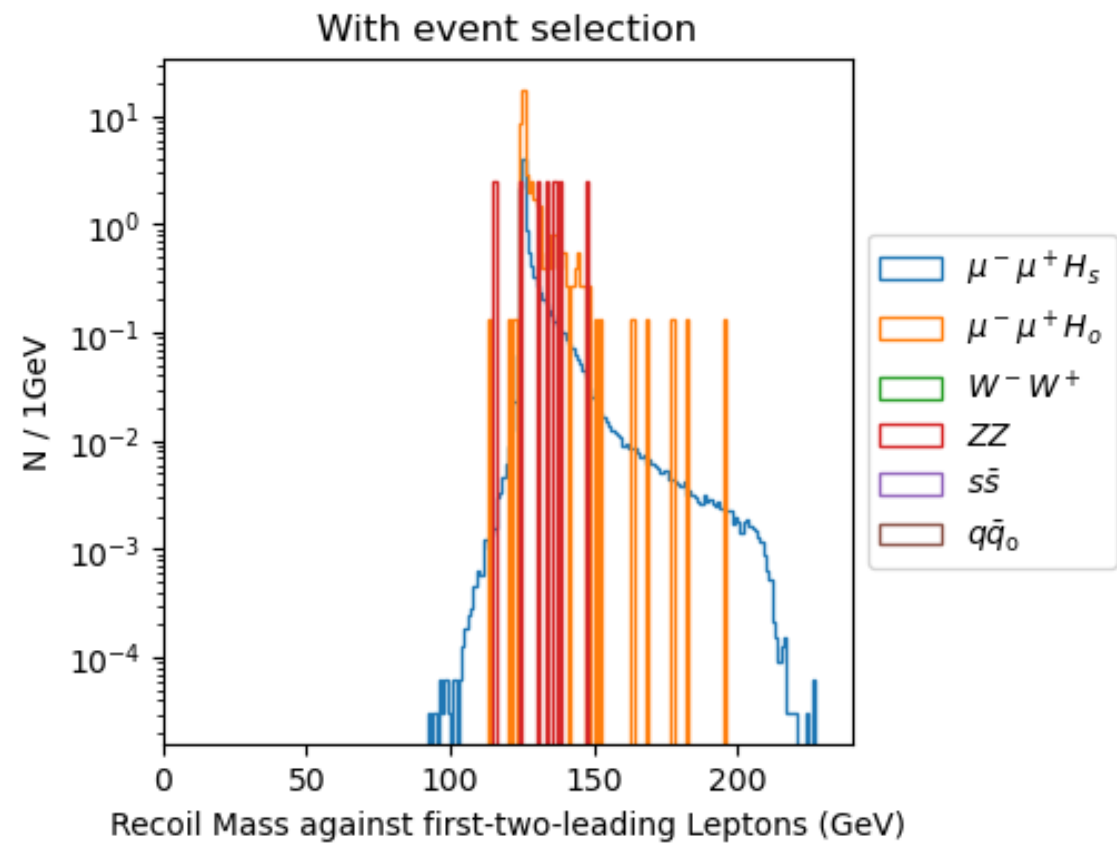
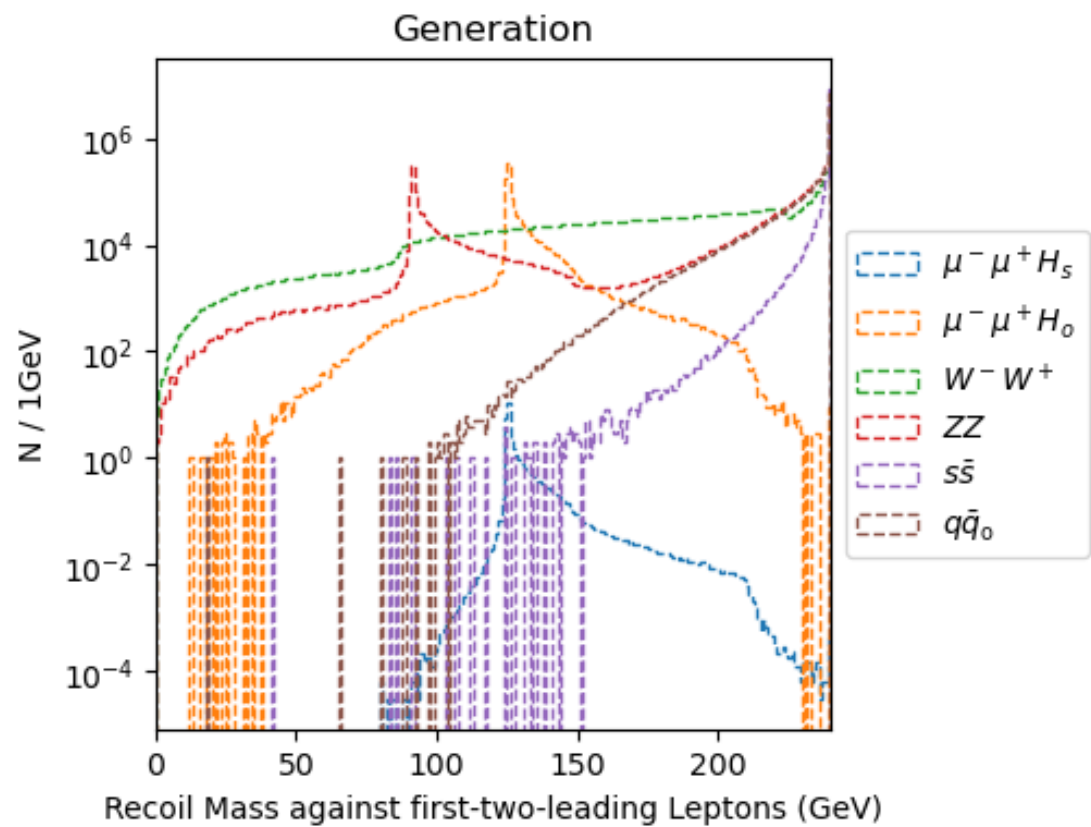
|   | channel    | Events | Monte Carlo Uncertainty | Events (unweighted) |
|---|------------|--------|-------------------------|---------------------|
| 0 | e2e2Hss    | 11     | 0.0185                  | 354733              |
| 1 | e2e2Hother | 47     | 3                       | 345                 |
| 2 | ww         | 0.0000 | 0.0000                  | 0                   |
| 3 | zz         | 17     | 7                       | 7                   |
| 4 | ss         | 0.0000 | 0.0000                  | 0                   |
| 5 | qqother    | 0.0000 | 0.0000                  | 0                   |

# Cut at 0.08









# Next

- Move to pythia8
- Move to delphes
- Compare scenarios
  - Perfect detector
  - Not perfect PID
- Classifier fusion
- Pre-cut approach
  - Keep signal  $> 90\%$ , train classifier dedicated for each classier

# Sample

|                   | Whizard1.9.5+Pythia6 | Pythia8 | Madgraph5 + Pythia8           | Whizard3.1 +Pythia8 |
|-------------------|----------------------|---------|-------------------------------|---------------------|
| ISR               | Y                    | Y       | Y                             | Y                   |
| ISR Pt            | Y                    | Y       | N                             | Y                   |
| Good Hard process | Y                    | ?       | Y                             | Y                   |
| comment           | old                  |         | Overestimate background of 2f |                     |

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