## Signal efficiency with recoil cut

## recoil> 110 GeV

| decay mode | counts | ZZ cut | WW cut | both cut | recoil cut | (\%) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| qqH all eLpR | 46,339 | 41,127 $888 \%$ | 42.508 <br> $91.7 \%$ <br> 1.8 | 38,269 $82.6 \%$ | 31,005 | $66.9 \%$ $\pm 0.2 \%$ |
| qqH all eRpL | 31,312 | 27,898 89,1\% |  | 22,568 286\% 826\% | 20,942 | 60.9\% 66.9\% +0.3 |
| H -> bb eLpR | 25,713 | 27.815 <br> 88.78 <br> 8.8 |  | 21,255 $827 \%$ 88 | 17,408 | 67.7\% +0.3\% |
| H $\rightarrow$ b bb eRpL | 17,271 | 158.314 887\% 88, | 15.917 <br> 1229 | 14,249 825 88 | 11,672 | 67.6\% +0.4\% |
| H -> WW eLpR | 10,627 | 8.746 <br> 88.94 <br> 8.9 | 92,659 <br> $9.0 \%$ <br> 1.02 | 82.750 8.95 8.90 | 7,262 | +0.3\% 68.3\% $\pm 0.5$ |
| H $\rightarrow$ WW eRpL | 7,220 | 6,430 890\% | 9,562 $.909 \%$ .909 | 5.923 $820 \%$ 8.0 | 4,937 | 68.4\% +0.5\% |
| H $\rightarrow$ Z Z l eLpR | 1,376 | 1,214 <br> $88.2 \%$ <br> 8.28 | 1,264 <br> 91.96 <br> 9. | 1,131 $822 \%$ | 939 | 68.2\% $\pm 1.3 \%$ a |
| H $\rightarrow$ Z ZZ eRpL | 938 | $\begin{array}{r}8224 \\ 8789 \\ \hline 88\end{array}$ | 867 | 7274 8756 | 643 | 68.6\% 68.5\% +15\% |
| $\mathrm{H}->r r$ eLpR | 172 | 161 | $\frac{26.401}{161}$ | $\frac{64.50}{152}$ | 104 | 60.5\% t37\% |
| $\mathrm{H} \rightarrow r$ r eRpL | 123 | $\begin{aligned} & 1.50513 \\ & 91.96 \end{aligned}$ | $\begin{gathered} 10009 \\ \hline 91.96 \end{gathered}$ |  | 74 | 60.2\% $\pm 4.4 \%$ |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

## more detail

recoil>1 10GeV

| decay mode | counts | ZZ cut | WW cut | both cut | recoil cut | (\%) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{H} \rightarrow$ WW eLpR | 10,627 | $\begin{aligned} & \hline 9,444 \\ & 88.9 \% \\ & \hline \end{aligned}$ | $\begin{aligned} & \hline 9,659 \\ & 91.0 \% \\ & \hline \end{aligned}$ | $\begin{aligned} & \hline 8,705 \\ & 81.9 \% \\ & \hline \end{aligned}$ | 7,262 | $\begin{aligned} & \hline 68.3 \% \\ & \pm 0.5 \% \\ & \hline \end{aligned}$ |
| $\mathrm{H} \rightarrow$ WW eRpL | 7,220 | $\begin{aligned} & \hline 6,430 \\ & 89.0 \% \\ & \hline \end{aligned}$ | $\begin{array}{r} 6,562 \\ 90.9 \% \\ \hline \end{array}$ | $\begin{array}{r} 5,923 \\ 82.0 \% \\ \hline \end{array}$ | 4,937 | $\begin{aligned} & \hline 68.4 \% \\ & \pm 0.5 \% \\ & \hline \end{aligned}$ |
| H->WW->hadronic L | $\begin{array}{r} 4,888 \\ 45.9 \% \\ \hline \end{array}$ | $\begin{gathered} 4,304 \\ 88.0 \% \end{gathered}$ | $\begin{array}{r} 4,568 \\ 93.5 \% \\ \hline \end{array}$ | $\begin{array}{r} 4,054 \\ 82.9 \% \\ \hline \end{array}$ | 3,243 | $\begin{array}{r} \hline 66.3 \% \\ \pm 0.7 \% \\ \hline \end{array}$ |
| H->WW->hadronic R | $\begin{array}{r} 3,305 \\ 45.8 \% \\ \hline \end{array}$ | $\begin{aligned} & \hline 2,911 \\ & 88.1 \% \\ & \hline \end{aligned}$ | $\begin{array}{r} \hline 3,090 \\ 93.5 \% \end{array}$ | $\begin{array}{r} \hline 2,745 \\ 83.1 \% \\ \hline \end{array}$ | 2,198 | $\begin{array}{r} 66.5 \% \\ \pm 0.8 \% \\ \hline \end{array}$ |
| H->WW->leptonic L | $\begin{aligned} & 1,068 \\ & 10.1 \% \\ & \hline \end{aligned}$ | $\begin{aligned} & \hline 1,068 \\ & 100 \% \\ & \hline \end{aligned}$ | $\begin{array}{r} 1,059 \\ 99.2 \% \\ \hline \end{array}$ | $\begin{array}{r} 1,059 \\ 99.2 \% \\ \hline \end{array}$ | 980 | $\begin{array}{r} 91.8 \% \\ \pm 0.8 \% \\ \hline \end{array}$ |
| H->WW->leptonic R | $\begin{gathered} 750 \\ 10.4 \% \\ \hline \end{gathered}$ | $\begin{gathered} 749 \\ 99.9 \% \\ \hline \end{gathered}$ | $\begin{gathered} 744 \\ 99.2 \% \\ \hline \end{gathered}$ | $\begin{gathered} 744 \\ 99.2 \% \\ \hline \end{gathered}$ | 686 | $\begin{array}{r} 91.5 \% \\ \pm 1.0 \% \\ \hline \end{array}$ |
| H->WW->semileptonic | $\begin{aligned} & 4,671 \\ & 44.0 \% \\ & \hline \end{aligned}$ | $\begin{gathered} 4,073 \\ 87.2 \% \\ \hline \end{gathered}$ | $\begin{gathered} 4,032 \\ 86.3 \% \\ \hline \end{gathered}$ | $\begin{aligned} & 3,592 \\ & 76.9 \% \\ & \hline \end{aligned}$ | 3,040 | $\begin{array}{r} 65.0 \% \\ \pm 0.7 \% \\ \hline \end{array}$ |
| H->WW->semileptonic | $\begin{array}{r} 3,166 \\ 43.8 \% \\ \hline \end{array}$ | $\begin{gathered} \hline 2,769 \\ 87.5 \% \\ \hline \end{gathered}$ | $\begin{array}{r} \hline 2,728 \\ 86.2 \% \\ \hline \end{array}$ | $\begin{aligned} & \hline 2,434 \\ & 76.9 \% \\ & \hline \end{aligned}$ | 2,053 | $\begin{array}{r} \hline 64.8 \% \\ \pm 0.8 \% \\ \hline \end{array}$ |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

## Outlook

- look H->ZZ decay as well.
- leptonic mode is not affected by cut at all.
- bb/WW are not consistent within efficiency uncertainty. -> should be investigated.
- analyze 2-jets and 3-jets clustering to decide cut box for semi-leptonic ZZ/WW.

