BR($h \to \tau^+\tau^-$) Study Status

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Recent Work

- MC stat. error estimation
  - some processes have large stat., and some processes have limited stat.
  - anyway, we can estimate the error of MC stat.

MC Stat. Error Estimation

- can be estimated by binominal distribution
  - $\Delta\varepsilon = \sqrt{\frac{\varepsilon(1-\varepsilon)}{N_G}}$ (ε: efficiency, N_G: # of MC events)
  - $\Delta n = N_G \Delta\varepsilon = \sqrt{n\left(1 - \frac{n}{N_G}\right)}$ (n: # of remained MC events)
  - If $n = 0$, I estimated with using Poisson distribution with CL = 68%.: $n = 0^{+1.8410}_{-0}$

Ex: qqh250 Cut-based Analysis

- $N_{sig} = 1016.0 \pm 3.1$
- Background
  - N(qqh, other) = 3.99 ± 0.75, N(llh, nnh) = 29.0 ± 2.0
  - N(2f) = $4.8^{+24.4}_{-2.5}$, N(4f) = 535^{+21}_{-20}, N(1f_3f) = $2.5^{+205}_{-1.4}$, N(aa_2f) = 0^{+439}_{-0}
- Significance = $25.47^{+0.22}_{-3.23}$, $\frac{\Delta(\sigma\times\mathrm{BR})}{(\sigma\times\mathrm{BR})} = 3.926^{+0.570}_{-0.033}\%$

Ex: qqh250 TMVA Analysis

- $N_{sig} = 1232.4 \pm 4.6$
- Background
  - N(qqh, other) = 1.91 ± 0.72, N(llh, nnh) = $20.1^{+2.5}_{-2.3}$
  - N(2f) = $9.3^{+48.9}_{-2.3}$, N(4f) = 512^{+29}_{-28}, N(1f_3f) = $1.8^{+409.8}_{-1.8}$, N(aa_2f) = 0^{+878}_{-0}
- Significance = $29.23^{+0.31}_{-5.79}$, $\frac{\Delta(\sigma\times \mathrm{BR})}{(\sigma\times \mathrm{BR})} = 3.421^{+0.845}_{-0.036}\%$

Ex: eeh250 Cut-based Analysis

- $N_{sig} = 69.89 \pm 0.38$
- Background
  - N(eeh, other) = 4.77 ± 0.83, N(mmh) = $0^{+0.27}_{-0}$, N(tautauh) = $0.0088^{+0.2697}_{-0.0087}$, N(qqh, nnh) = $0.17^{+0.33}_{-0.15}$
  - N(2f) = $1.5^{+24.4}_{-1.5}$, N(4f) = $39.3^{+7.9}_{-4.5}$, N(1f_3f) = $0.35^{+204.89}_{-0.35}$, N(aa_2f) = 0^{+439}_{-0}
- Significance = $6.49^{+0.16}_{-3.65}$, $\frac{\Delta(\sigma \times \mathrm{BR})}{(\sigma \times \mathrm{BR})} = 15.41^{+19.80}_{-0.37}\%$

Combined Results: 250 GeV

250 fb^{-1} significance	$q\bar{q}h$	e^+e^-h	$\mu^+\mu^-h$	$\nu\bar{\nu}h$
Cut-based	$25.47^{+0.22}_{-3.23}$	$6.49^{+0.16}_{-3.65}$	$8.22^{+0.20}_{-4.29}$	$2.555^{+0.022}_{-0.060}$
TMVA	$29.23^{+0.31}_{-5.79}$	$6.93^{+0.23}_{-4.46}$	$8.84^{+0.22}_{-5.79}$	$3.087^{+0.029}_{-0.097}$

Cut-based:

Combined significance = $27.66^{+0.34}_{-6.49}$

precision = $\frac{\Delta(\sigma\times\mathrm{BR})}{(\sigma\times\mathrm{BR})} = 3.615^{+1.109}_{-0.044}\%$

TMVA:

Combined significance = $31.47^{+0.45}_{-9.41}$

precision = $\frac{\Delta(\sigma\times\mathrm{BR})}{(\sigma\times\mathrm{BR})} = 3.178^{+1.355}_{-0.045}\%$

Combined Results: 500 GeV (except eeh)

500 fb^{-1} significance	$q\bar{q}h$	$\mu^+\mu^-h$	$\nu\bar{\nu}h$
Cut-based	$20.07^{+0.48}_{-2.88}$	$4.970^{+0.095}_{-2.541}$	$12.25^{+0.21}_{-0.21}$
TMVA	$21.63^{+0.67}_{-1.94}$	$5.604^{+0.089}_{-3.476}$	$14.51^{+0.21}_{-0.31}$

Cut-based:

Combined significance = $24.30^{+0.53}_{-3.85}$

precision = $\frac{\Delta(\sigma\times\mathrm{BR})}{(\sigma\times\mathrm{BR})} = 4.115^{+0.775}_{-0.088}\%$

TMVA:

Combined significance = $26.64^{+0.71}_{-3.99}$

precision = $\frac{\Delta(\sigma\times\mathrm{BR})}{(\sigma\times\mathrm{BR})} = 3.754^{+0.661}_{-0.098}\%$

Summary

- Estimation of MC stat. error has been performed.
  - There is a discussion of overestimation.
- The final results will not so affected, the effect for sensitive channel is not so large.
- O(%) can be achieved even considering MC stat. error (3 - 5% level) at 250 GeV and 500 GeV.
- Summarize as soon as possible...