$\mathrm{H} \longrightarrow \mu\mu$ @ 1 TeV Update

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ILD Analysis & Software Meeting

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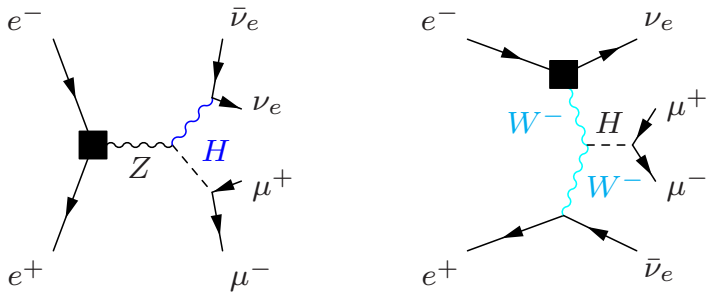
$H \to \mu\mu$

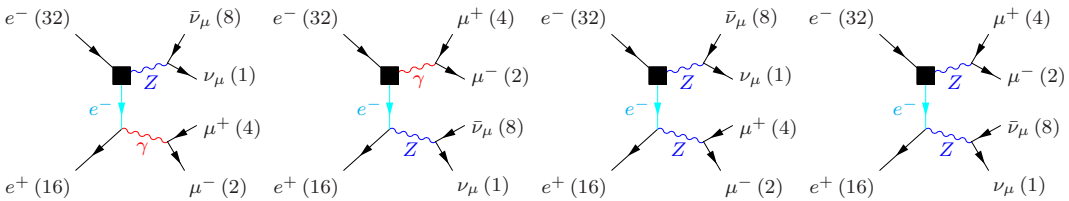


$H \to \mu\mu$

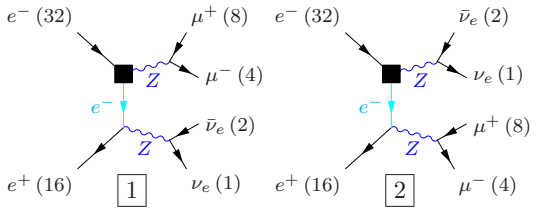
- E=1 TeV
- cross section: 748.4 fb^{-1}(lr), 5.905 fb^{-1}(rl)
- branching ratio: 0.000221
  - $\approx$ 45 events with L=500 $\mathrm{fb}^{-1}$and (e^{-1},e^{+1})=(-0.8,$+0.2$)
  - $\approx$ 4 events with L=500 $\mathrm{fb}^{-1}$and (e^{-1},e^{+1})=($+0.8$,-0.2)
- ILCSOFTv16
- Included overlay $\gamma\gamma \to$ hadrons (NEW)

Main Background Sources

- Main background: $ZZ(WW) \longrightarrow \nu\nu\mu\mu$,$Z \longrightarrow \nu\nu\mu\mu$



$$ZZ(WW) \longrightarrow \nu\nu\mu\mu$$



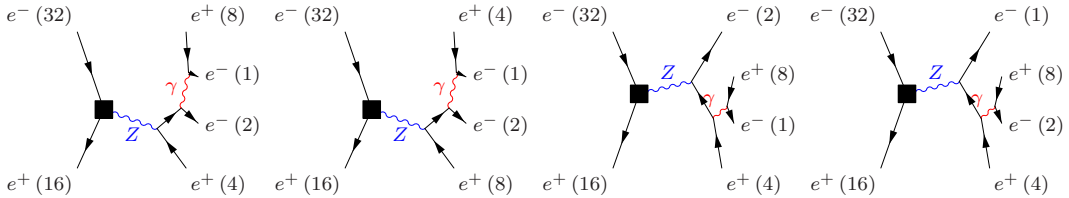
$$Z \longrightarrow \nu\nu\mu\mu$$

- Only showed a few of the total Feynman diagrams.
- same final state as the signal.

Other Background Sources

Other sources considered:

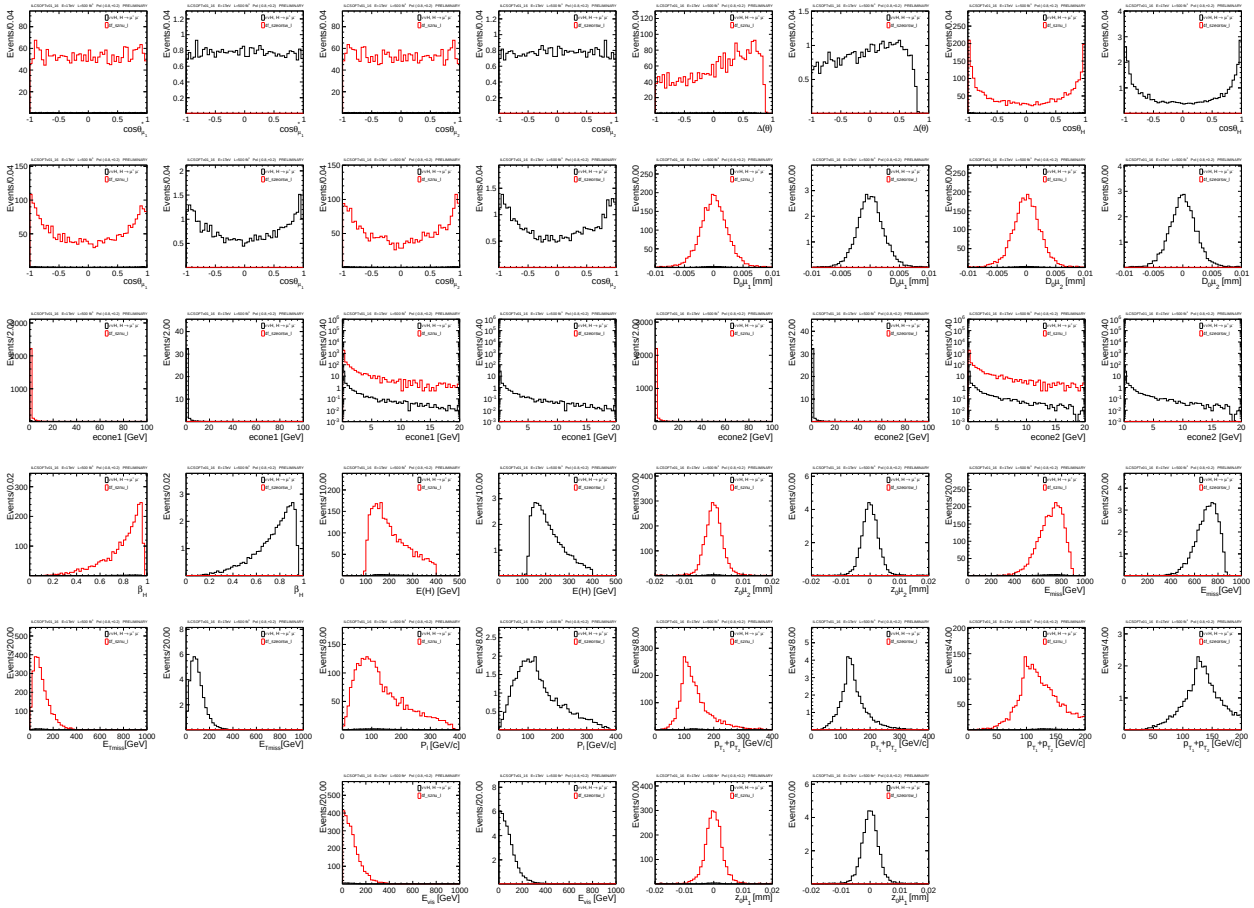
- $\mu\mu e^+e^-$ (leptons being forward)



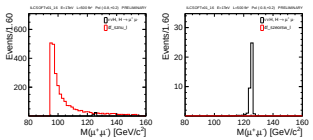
- $Z \longrightarrow \mu\mu$
- 4f_sw_l
- 4f_ww_l
- 4f_zz_l

Signal VS sznu_l Distributions

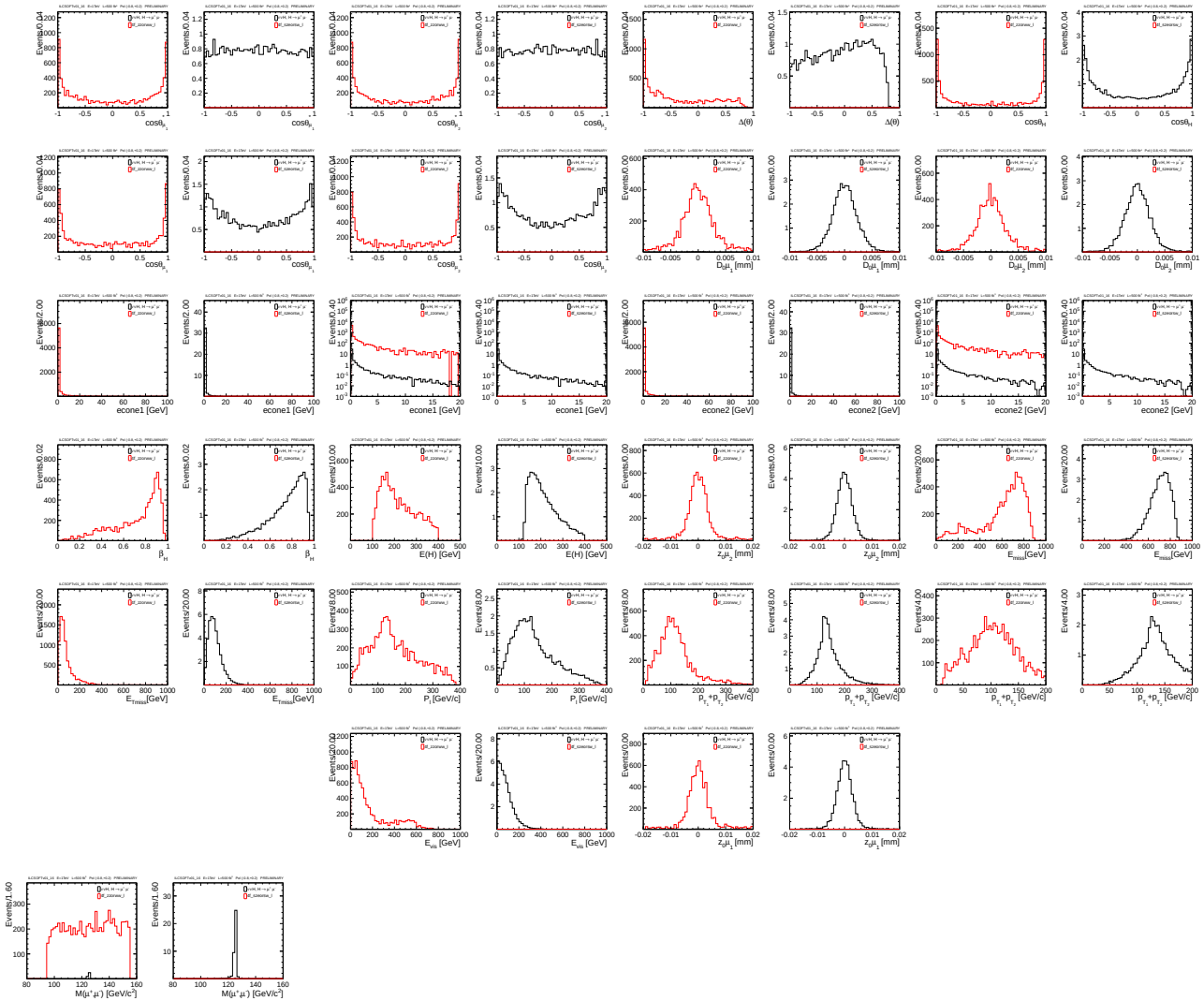
- Event Variables looks very similar.



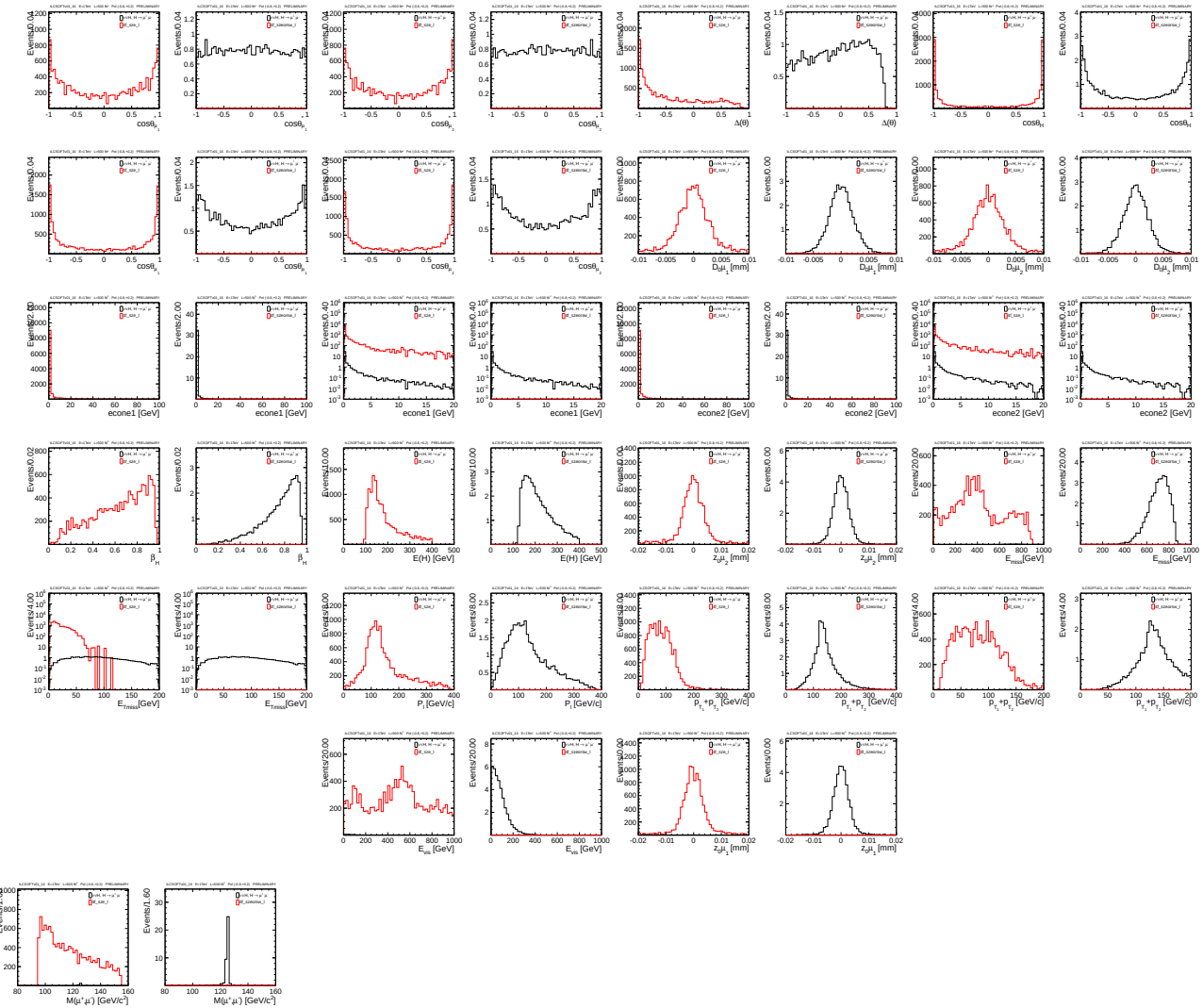
- Only the mass looks different.



Signal VS zzorww_l Distributions

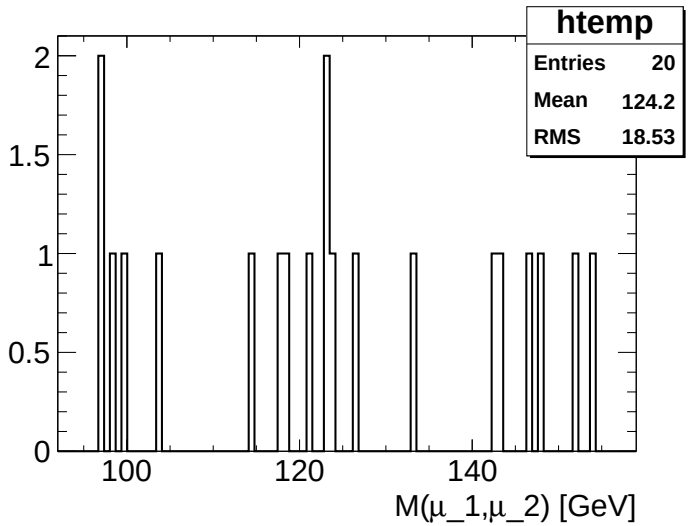


Signal VS sze_l Distributions

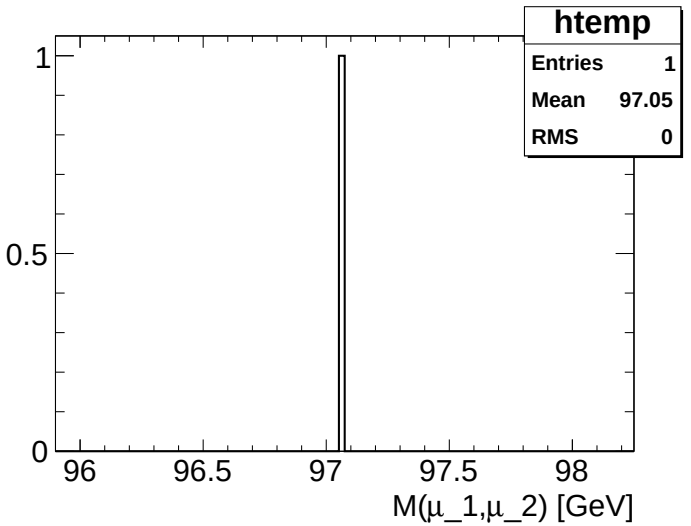


$\gamma\gamma \rightarrow \mu^+\mu^-$

- Checked $\gamma\gamma \rightarrow \mathrm{ff}$ samples, sim/reco 10000 events (97 pb^{-1})
- Cut $Et_{miss} > 40$ GeV removes all events from the signal region.
- Statistics is small attending the high cross section of this process ($\approx 1.0 \times 10^5$).



Preselection



$Et_{miss} > 40$

Preselection

2 Muons

- $E > 15$ GeV
- $E_{calE}/(E_{calE} + E_{calH}) < 0.5$
- $(E_{calE} + E_{calH})/|\vec{P}| < 0.3$

H candidate

- $E_{muon1} + E_{muon2} < 400$ GeV
- $|M(\mu^+, \mu^-) - 125| < 30$ GeV/c^2

- No isolation requirement.
- checked efficiency/purity on muon selection (next slide)
  - efficiency: # muons selected / # reconstructed muons $E > 15$ GeV
  - purity: # muons selected / # PFO's passing selection

Muon Selection Efficiency/Purity

process	effi (%)	purity(%)
signal	98.1747	99.8674
2f_z_bhabhag	NA	0
2f_Z_hadronic	95	37.2549
2f_Z_leptonic	95.4683	95.4683
4f_WW_leptonic	98.1707	95.2663
4f_ZZWWMix_hadronic	92.3077	21.0526
4f_ZZWWMix_leptonic	97.4763	96.5625
4f_ZZ_hadronic	94.7368	45.5696
4f_ZZ_leptonic	96.1123	97.8022
4f_ZZ_semileptonic	98.1595	85.5615
4f_singleW_leptonic	99.0741	99.0741
4f_singleZnunu_leptonic	98.0831	99.3528
4f_singleZnunu_semileptonic	100	52.381
4f_singleZsingleWMix_leptonic	NA	0
4f_singleZee_semileptonic	100	27.2727
4f_singleZee_leptonic	97.7778	95.6522
4f_WW_semileptonic	96.4103	87.4419
4f_singleW_semileptonic	100	31.25

- High efficiency/purity for the relevant modes (leptonic final states).

Summary

$\mathrm{H} \rightarrow \mu\mu$

- Included overlay $\gamma\gamma \rightarrow \mathrm{hadrons}$
  - Some cuts are not suitable anymore or change (num PFO's, visible energy)
  - Working on final selection with this more realistic enviroment.
  - Rec cuts analysis in this week.
- Size of $\gamma\gamma \rightarrow \mu^+\mu^-$ contribution is still not clear.
  - It seems that cut on minimum Et_{miss} would help
  - But performed check with low statistics.

Back up