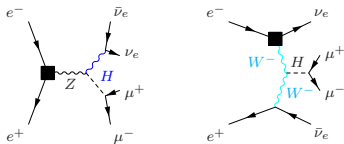


$H \rightarrow \mu\mu$ @ 1 TeV Update

C. Calancha (KEK, IPNS)
Weekly Physics & Software Meeting

November 30th, 2012

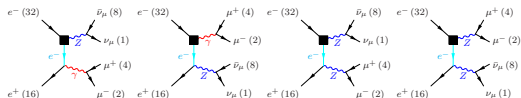
$H \rightarrow \mu\mu$



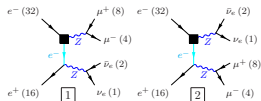
$H \rightarrow \mu\mu$

- $E=1$ TeV
- cross section: $748.4 \text{ fb}^{-1}(\text{lr}), 5.905 \text{ fb}^{-1}(\text{rl})$
- branching ratio: 0.000221
 - ≈ 45 events with $L=500 \text{ fb}^{-1}$ and $(e^{-1}, e^{+1})=(-0.8, +0.2)$
 - ≈ 4 events with $L=500 \text{ fb}^{-1}$ and $(e^{-1}, e^{+1})=(+0.8, -0.2)$
- ILC SOFTv16
- Included overlay $\gamma\gamma \rightarrow \text{hadrons}$

Main Background Sources



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



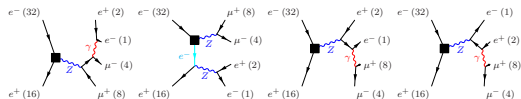
$$Z \rightarrow \nu\nu\mu\mu$$

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

Other Background Sources

Other sources considered:

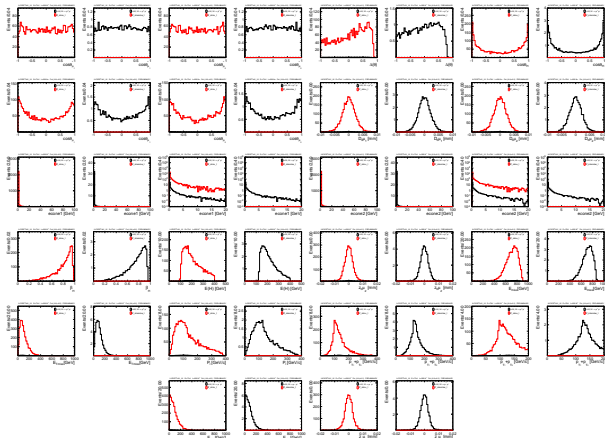
- $\mu\mu e^+e^-$ (leptons being forward)



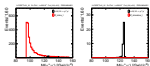
- $Z \rightarrow \mu\mu$
- 4f_sw_l
- 4f_ww_l
- 4f_zz_l

Signal VS sznu_I Distributions

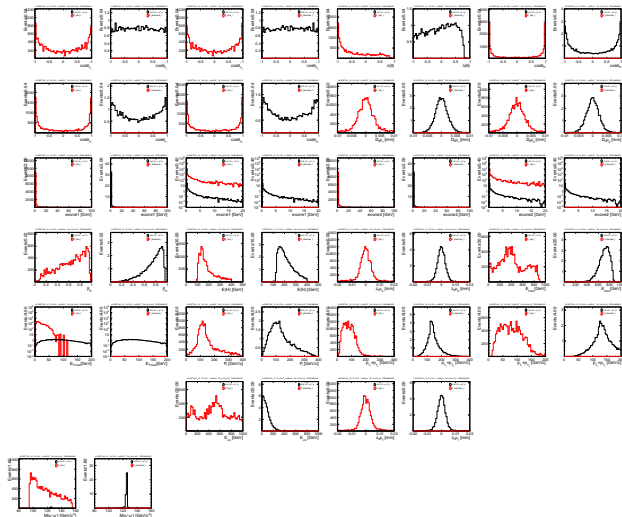
- Event Variables looks very similar.



- Only the mass looks different.



Signal VS size_I Distributions



2 Muons

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

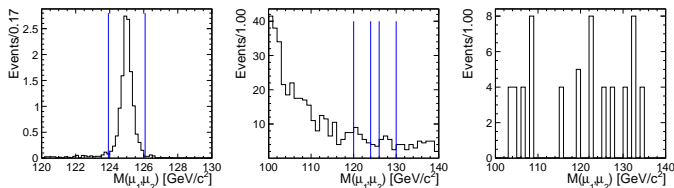
H candidate

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

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

Estimation of $\Delta(\sigma \cdot Br)/\sigma \cdot Br$

Naive Estimation of $\Delta(\sigma \cdot Br)/\sigma \cdot Br$



- Signal: 3σ ($\sigma \approx 0.36 \text{ GeV}/c^2$) around peak
- sznu: sidebands (120,124) & (126,130)
- zzorww: assumed flat, averaged over (100,140)

→ Normalized number of background events to signal window size

Yields

- Signal: 12.4
- sznu: 6.21
- zzorww: 1.62

$$\bullet \frac{\Delta(\sigma \cdot Br)}{\sigma \cdot Br} = \frac{\sqrt{S+B}}{S} = 36.3 \%$$

(This is for $L = 500 \text{ fb}^{-1}$)

Estimation of $\Delta(\sigma \cdot Br)/\sigma \cdot Br$

- Alternative calculation provides 34 %
 - Fitting s_{ZNU} and extrapolating integral in region (124.53, 125.47)
 - Previous slide used bigger signal region definition (123.92, 126.08)
- Method using toy MC still under development
- No good fit to the data, so no realistic templates to generate toy samples. :-)

Summary

$$\begin{aligned} H &\rightarrow \mu\mu \\ &\rightarrow \frac{\Delta(\sigma \cdot Br)}{\sigma \cdot Br} \end{aligned}$$

- Estimated **36.3 %** ($L = 500 \text{ fb}^{-1}$, beam pol. $Pe^-, Pe^+ -0.8, +0.2$) counting (using sidebands for background).
- Alternative method with toy MC under study.
 - Extraction of templates from data.
 - Generation with these templates of many independent datasets.
 - Fit with same templates.
- Not good fit to data yet in order to extract templates.
- Writing Public Note describing analysis.

Back up

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_singleZnu_nu_leptonic	98.0831	99.3528
4f_singleZnu_nu_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).