

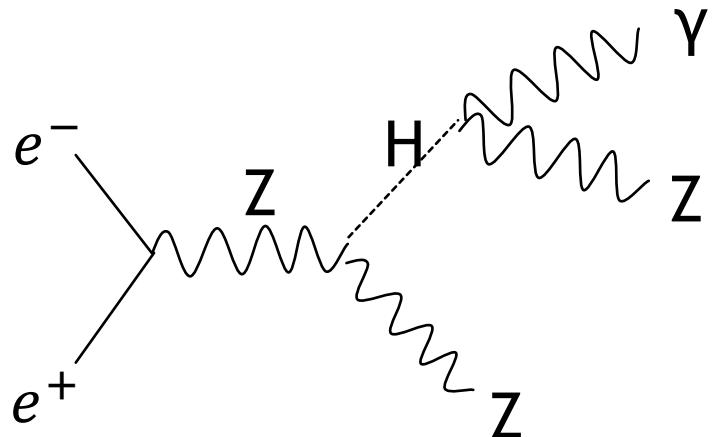


Analysis of $H \rightarrow Z\gamma$ decay channel at the ILC center of mass energy 250GeV

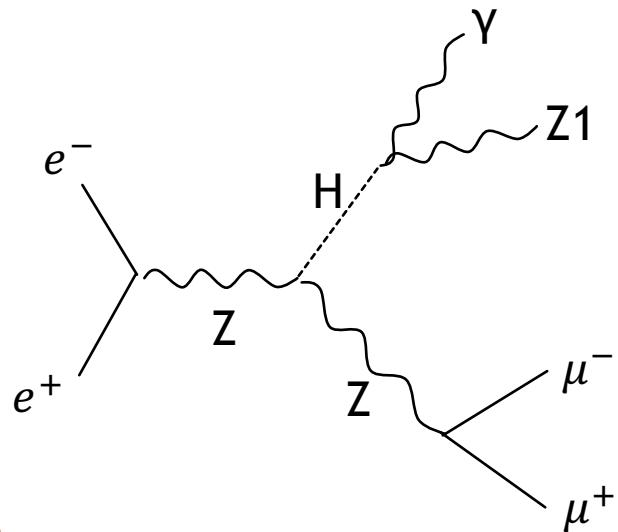
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Motivation

- ▶ In SM, BR of Higgs to γ and Z is 0.154%.
 - ▶ In BSM, this BR is expected more larger.
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- ▶ In this study, we evaluate sensitivity of $Z \rightarrow HZ \rightarrow \gamma ZZ$ at ILC .
 - ▶ Goal : Significance >3.0 with all channels.

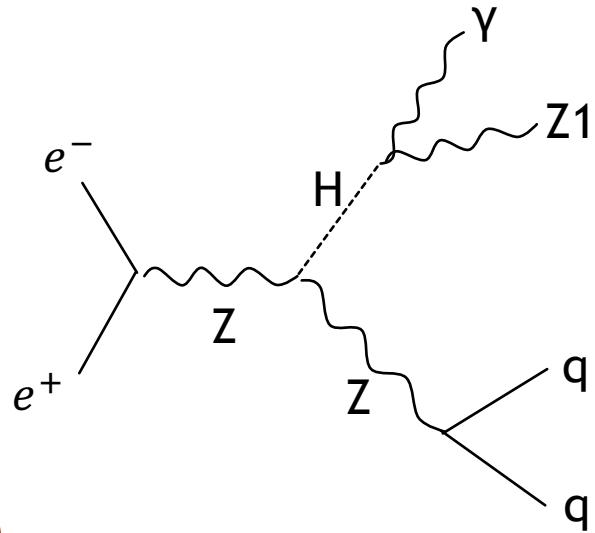


Analyzed channel 1



- At 250 GeV in SM
- $\sigma_{LR} = 17.14 \times 0.154\% \text{ } fb$
- $\sigma_{RL} = 10.98 \times 0.154\% \text{ } fb$
- Set up
- $L = 2000 \text{ } fb^{-1}$ (assumed)
- $(P_{e^-}, P_{e^+}) = (-0.8, +0.3)$
- 32.04 events expected**
- First, I analyzed $Z_1 \rightarrow qq$ channel

Analyzed channel 2



► At 250 GeV in SM

$$\sigma_{LR} = 0.536320274 \text{ fb}$$

$$\sigma_{RL} = 0.344024887 \text{ fb}$$

► Set up

$$L = 2000 \text{ fb}^{-1} (\text{assumed})$$

$$(P_{e^-}, P_{e^+}) = (-0.8, +0.3)$$

651.6 events expected

► First, I analyzed $Z1 \rightarrow \mu\mu$ channel

Progress

- Compared BDT with BDTG
- Compared significance among 4 methods with TMVA

Methode of Higgs selection

1. $Z + \gamma$ mass
2. Recoil mass
3. Z momentum
4. Z momentum in H rest frame

Setting & Flow of Analysis

- ▶ Setting
 - ▶ iLCSoft:v1_16_02
 - ▶ Samples: DBD sample
 - + Dirac sample ($e^+e^- \rightarrow ZH, Z \rightarrow \mu\mu, H \rightarrow Z\gamma$)
 - + Dirac sample ($e^+e^- \rightarrow ZH, Z \rightarrow qq, H \rightarrow Z\gamma$)
 - ▶ Detector: ILD full simulation
 - ▶ $E_{cm} = 250 \text{ GeV}, \int L dt = 2000 \text{ fb}^{-1}$, $(P_{e^-}, P_{e^+}) = (-0.8, +0.3)$
- ▶ Flow of analysis
 - ▶ Isolated lepton pair selection
 - ▶ Isolated photon selection
 - ▶ 2 jets clustering using Durham(LCFIPlus)
 - ▶ Event selection with H reconstruction using H mass(next page)
 1. TMVA base

TMVA

- ▶ Seted up TMVA environment.
- ▶ Used M_H , $M_{Zrecoil}$, $\cos\theta_{z1}$, $\cos\theta_\gamma$, E_{Z1} , E_γ
- ▶ Cut Table
 1. Lepton pair's particle ID = 13(muon)
 2. $80 \text{ GeV} < M_{Z1} < 100 \text{ GeV}$, $60 \text{ GeV} < M_{Z2} < 120 \text{ GeV}$, $M_\gamma < 0.1 \text{ GeV}$
 3. Number of charged particles in each jets > 2
 4. TMVA variables cut

ZH-> $\mu\mu$ H channel

mumu	BDT			BDTG		
	SigN	BkgN	Signi	SigN	BkgN	Signi
method1	6.99	121.84	0.616	4.7	39.17	0.709
method2	7.4	136.5	0.617	4.53	28.28	0.79
method3	7.06	119.82	0.627	4.09	25.91	0.747
method4	7.16	155.98	0.56	3.94	23.25	0.755

ZH->qqH channel

qq	BDT			BDTG		
	SigN	BkgN	Signi	SigN	BkgN	Signi
method1	7.45	169.47	0.56	7.27	131.55	0.617
method2	8.65	343.87	0.461	5	65.32	0.596
method3	8.55	296.94	0.489	4.12	45.84	0.582
method4	8.21	257.84	0.503	6.47	114.48	0.588

ZH \rightarrow qqH + ZH $\rightarrow\mu\mu H$

all	BDT			BDTG		
	SigN	BkgN	Signi	SigN	BkgN	Signi
method1	17.7	376.81	0.891	13.14	162.04	0.993
method2	17.04	371.83	0.864	11.12	120.44	0.97
method3	17.34	373.1	0.879	13.59	186.97	0.96
method4	15.53	321.62	0.846	15.23	257.06	0.923

Problems

- ▶ cannot make root file from TMVA
(Researching & debugging)
- ▶ Kolmpgrov-Smirnov test's probability is too small

backup

Result of pre-selection

	No Cut	Pre-selecion
Signal	32.04629	24.494998
2f_z_bhabhag	50366740	7430149
2f_z_l	25987700	612571
4f_sze_sl	756562	162953
4f_sze_l	2106889	124199
4f_zz_sl	1713857	77461
Other bkg	233227790	43559

