
An additional mode for Higgs boson reconstruction

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General idea

In LHC the most clean Higgs decay channel is in four leptons:

$$H \rightarrow Z (\ell_1 \ell_2) Z^* (\ell_3 \ell_4) \quad \ell = \mu \text{ or } e$$

At ILC in this channels with 2 ab^{-1} : $6 \times 10^5 \times 0.026 \times 0.068 \times 0.068 \approx 70 \text{ ev.}$

$$\text{Bf} (H \rightarrow ZZ^*) \sim 2.6 \%, \quad \text{Bf} (Z \rightarrow \mu\mu / ee) \sim 3.4\%$$

My idea, which I would like to propose:

$$H \rightarrow Z (j_1 j_2) Z^* (\ell_3 \ell_4) \quad j = b \text{ or } c \text{ jet}, \quad \ell = \mu \text{ or } e$$

$$\text{Bf} (Z \rightarrow b\bar{b}) \sim 15 \%, \quad \text{Bf} (Z \rightarrow c\bar{c}) \sim 12 \%, \quad \text{Bf} (Z \rightarrow \text{hadrons}) \sim 70 \%$$

Improvement in event number at least factor 4, or ~ 280 events with 2 ab^{-1}

Selections

Two opposite sign muons or electrons

It will provide a strong suppression, clean preselected data sample

Two jets with mass around Z mass

Mass difference: $M(jj\ell\ell) - M(jj) + M(Z)$ at the region of Higgs mass

Signal peak in mass difference should be narrow, comparing with direct mass

For $e^+e^- \rightarrow ZH$ channel, mass constraint fit to $M(jj)$, then get $M(jj\ell\ell)$

Missing mass to Higgs should be around Z mass

Efficiency should not be small

⇒ we can expect rather clean signal and enough events to observe peak

Conclusions

This channel can be used to measure Higgs width Γ_H , mass M_H , and CP-violation effects.

$$\sigma(\text{HZ}) \times \text{Bf}(H \rightarrow ZZ^*) = C g_Z^4 / \Gamma_H$$

We plan to investigate this opportunity.

Probably a detailed simulation can be done by my student.

Why LHC does not look for signal in this channel? Large background?