Matrix Element Method for ILC Physics Analysis

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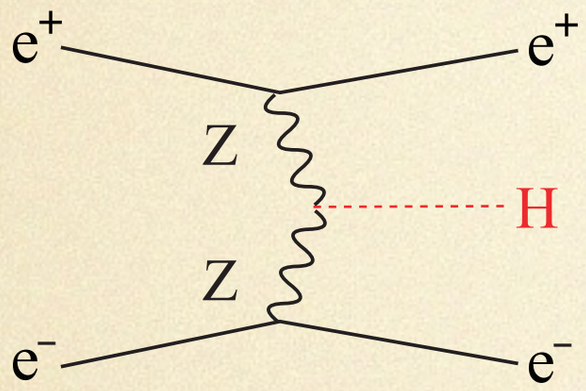
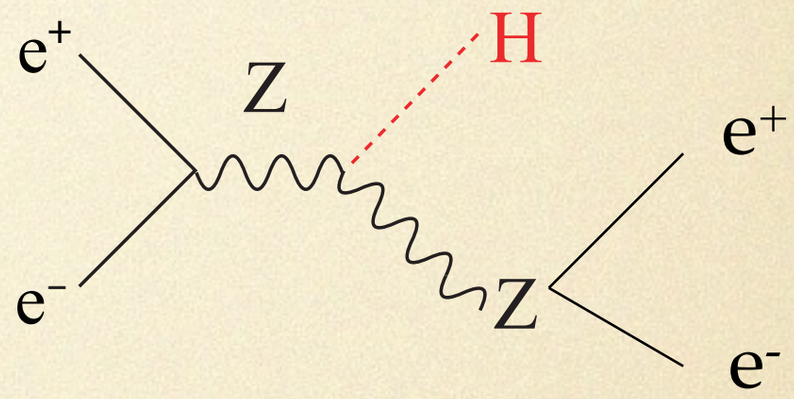
http://ilcphys.kek.jp/meeting/physics/archives/2009-05-19/GGGuide.pdf

first application: e+e- —> e+e-H





- to discover the Higgs production channel via ZZ-fusion.
- provide another HZZ coupling measurement, important at high energies (σ_S=0.7/7.5/22.8 fb @ 250/500/1000 GeV).
- crucial to discriminate events via ZH production.
- relatively straightforward to apply ME method, since kinematics can be fully reconstructed! and LCMEEEH and LCMEZH are ready.
- a new analysis @ ILC is being setup, samples are generated with DBD softwares, with restrictions in generators.

$$e^+ + e^- \rightarrow e^+ e^- H \rightarrow e^+ e^- b\bar{b}$$

full simulation @ 500GeV
samples with DBD software

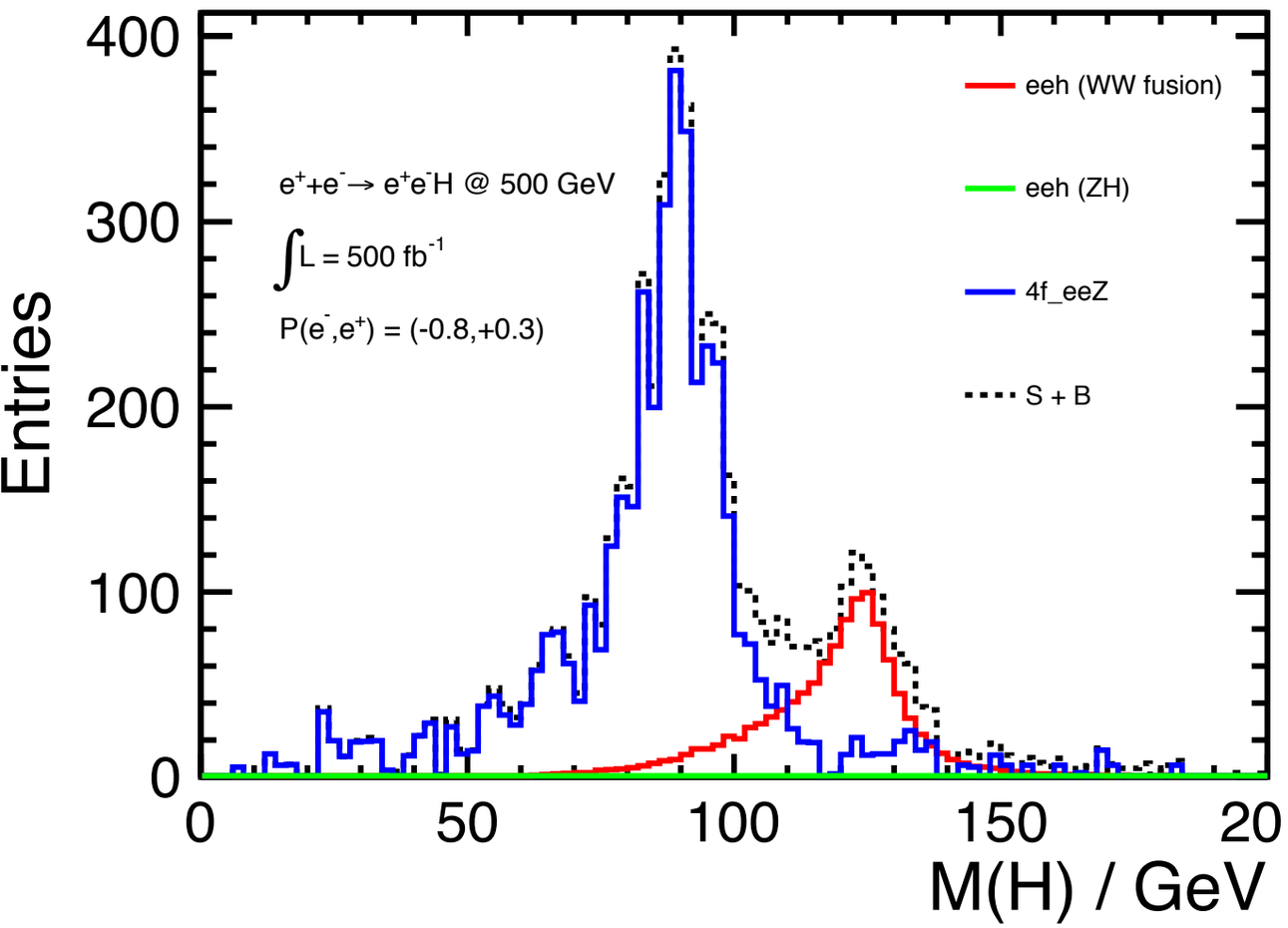
pre-selection:

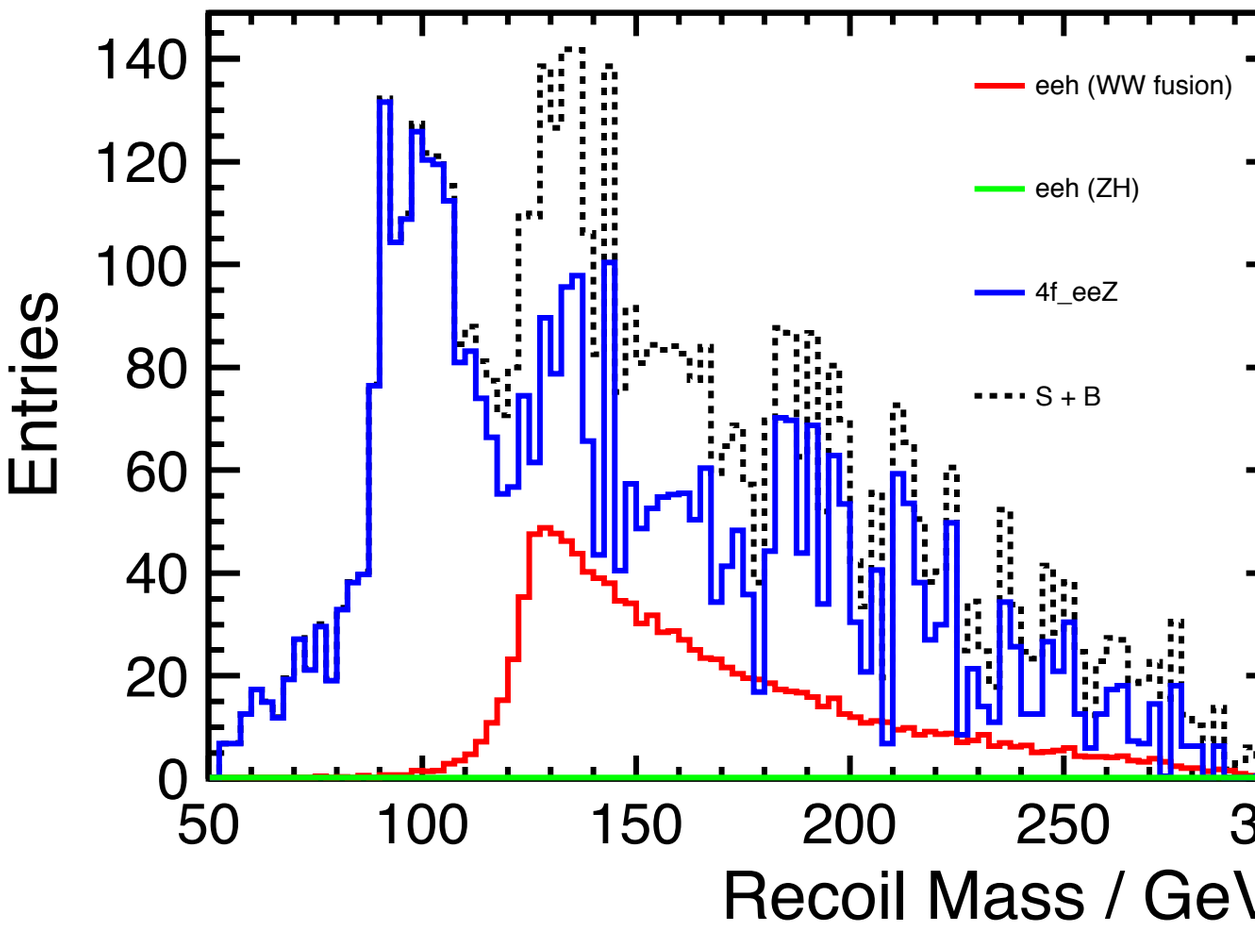
- select two isolated electron w/ BS and FSR recovered (MVA)
- fastjet (kt) algorithm to remove the very forward overlaid particles
- two jets clustering and flavor tagging

final-selection:

- more strict cuts on electrons: MVA>0.8, $P_1+P_2>200$, $\cos\theta 12<-0.14$ (cut1)
- two-jets: Npfos > 8 (cut2)
- PtH > 10, MissPt < 60 (cut3)
- flavor-tagging: btag1 + 2*btag2 > 1.0 (cut4)
- Higgs mass: (105, 155), recoil mass > 110 (cut5)

some distributions





signal and backgrounds (reduction table)

$$e^+ + e^- \to e^+ e^- H \to e^+ e^- b\bar{b}$$

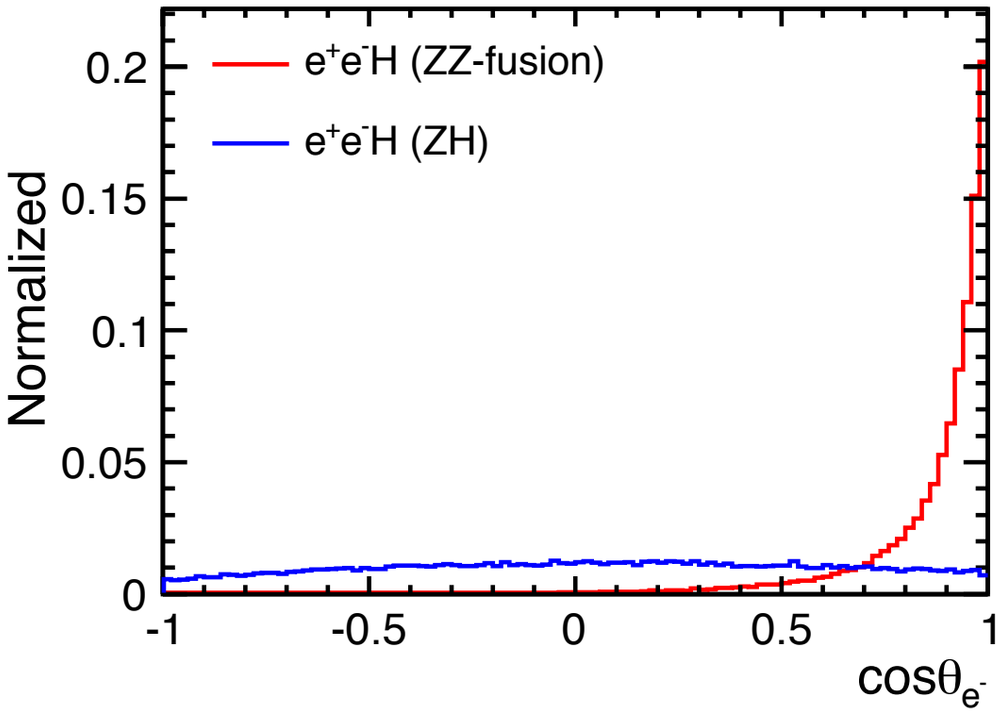
Polarization: (e-,e+)=(-0.8,+0.3) $E_{\rm cm} = 500{\rm GeV}, M_H = 125{\rm GeV}$ $\int {\rm L} = 500\ {\rm fb}^{-1}$

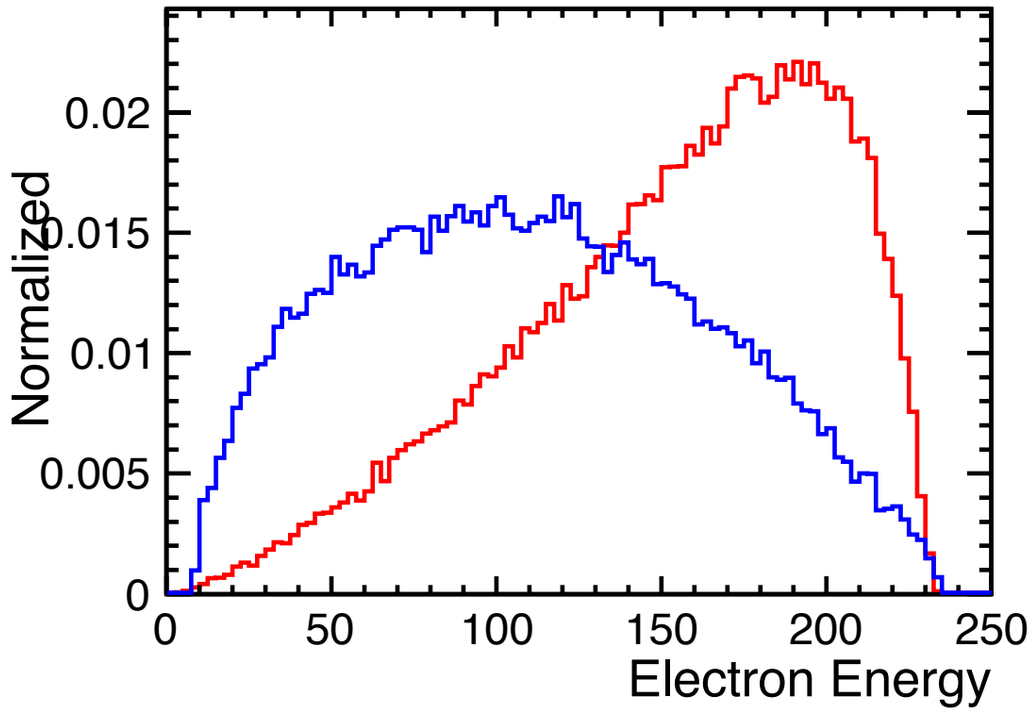
	Expected	pre-selction	cut1	cut2	cut3	cut4	cut5
eeh (fusion)	3.74×10	2685	2313	1930	1886	1179	935 (918)
eeh (ZH)	1.72×10	1541	30.7	8.8	7.6	3.2	2.5
eeZ	4.88×10	301261	115353	28073	26601	4261	300
BG	2.78×10	3.72×10	1.38×10	2.97×10	2.72×10	4471	359
significance	0.41	2.5	3.6	7.2	7.4	15.3	25.5

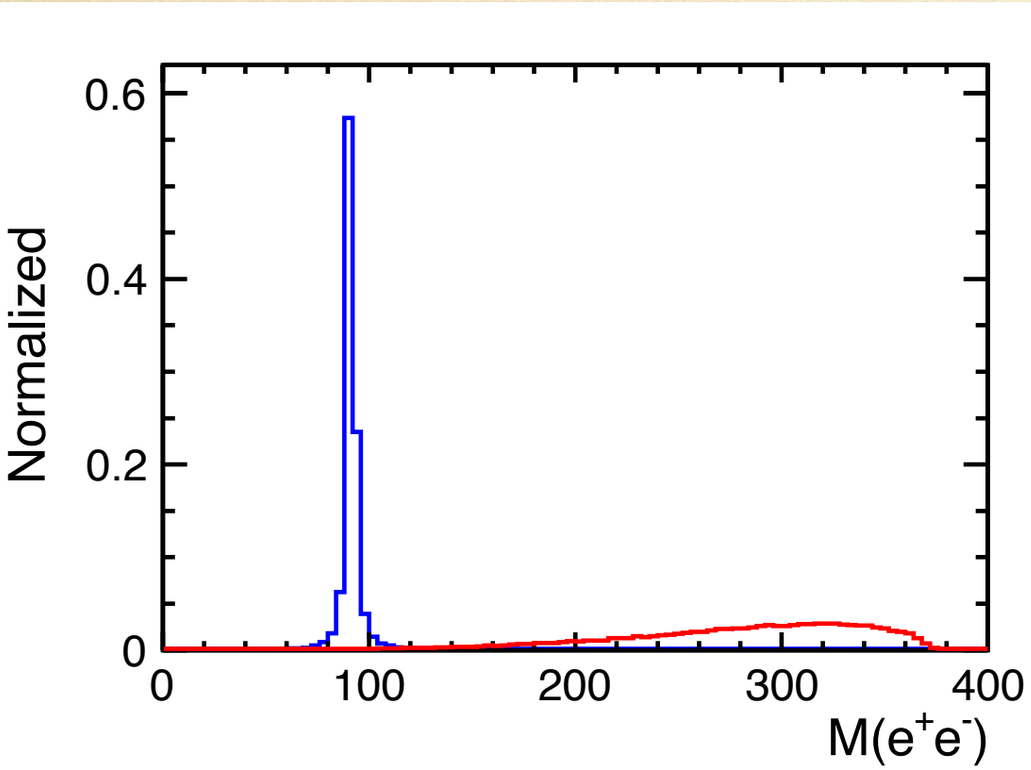
$$\frac{\delta(\sigma_{eeH} \cdot {\rm Br}(H \to b\bar{b}))}{\sigma \cdot {\rm Br}} = 3.9\%$$

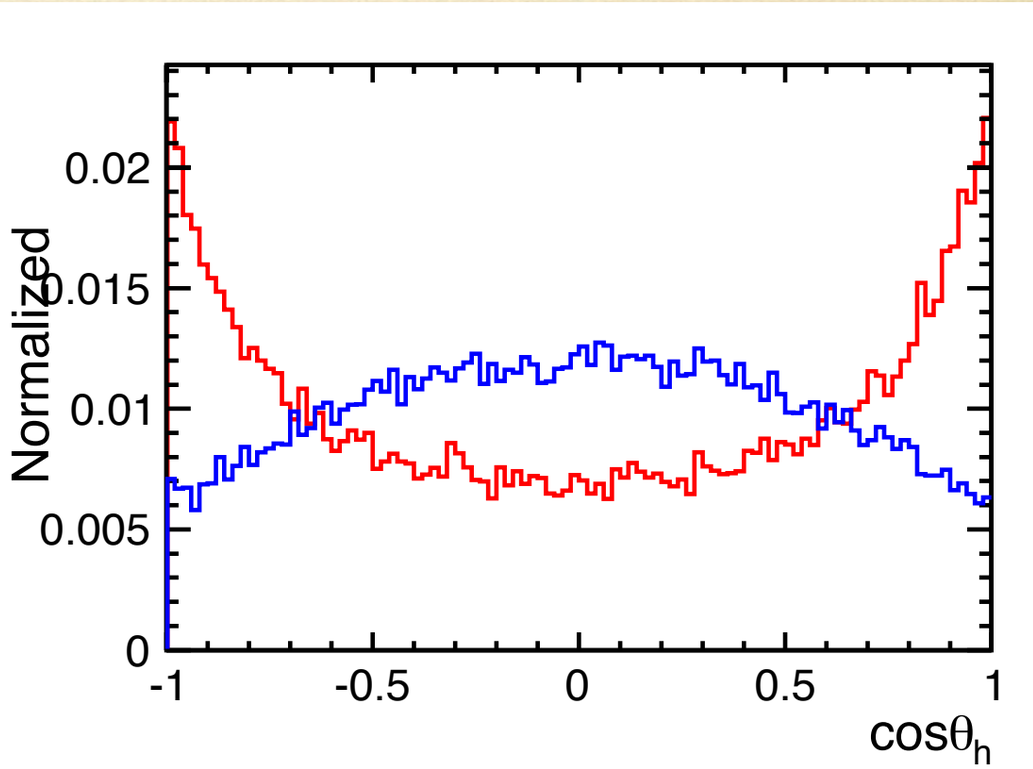
back up

some distributions



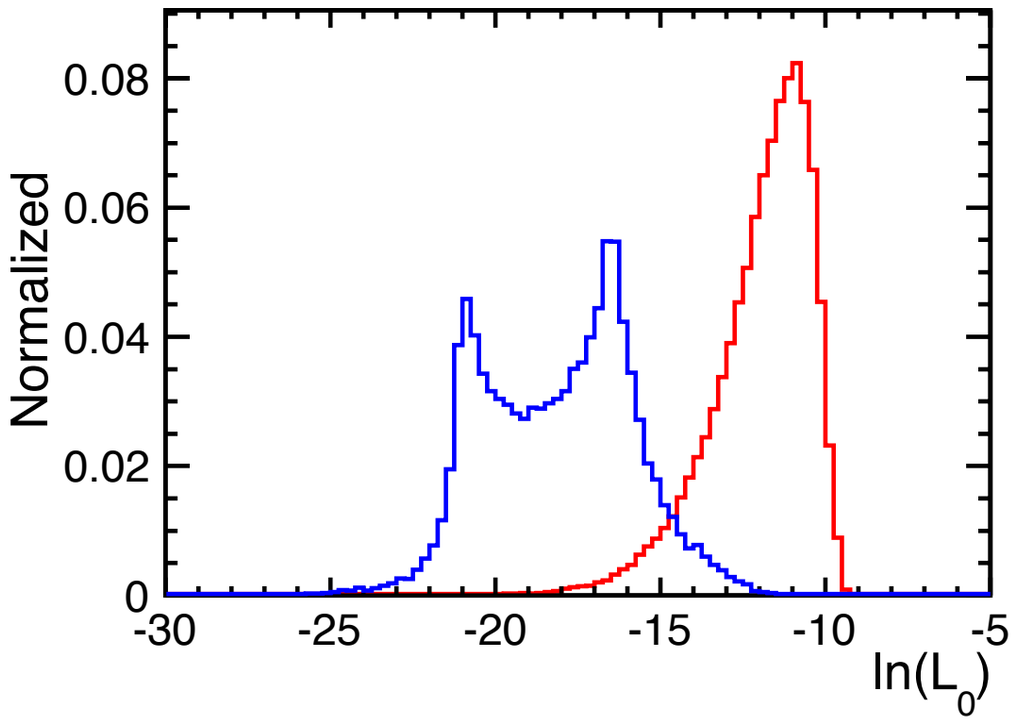




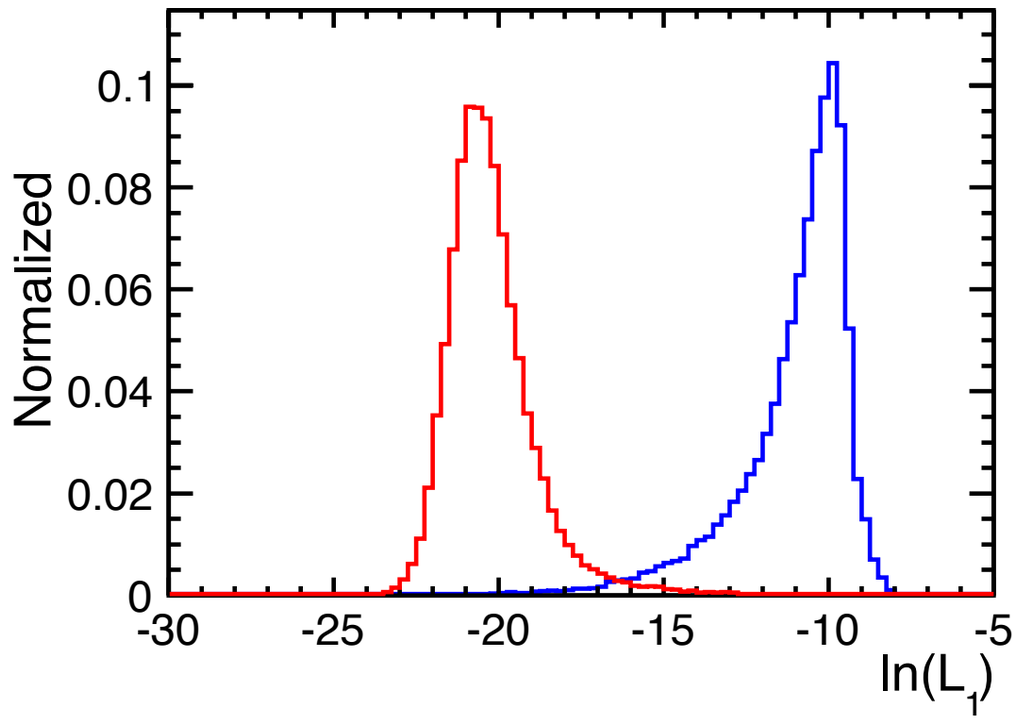


matrix elements (generator level)

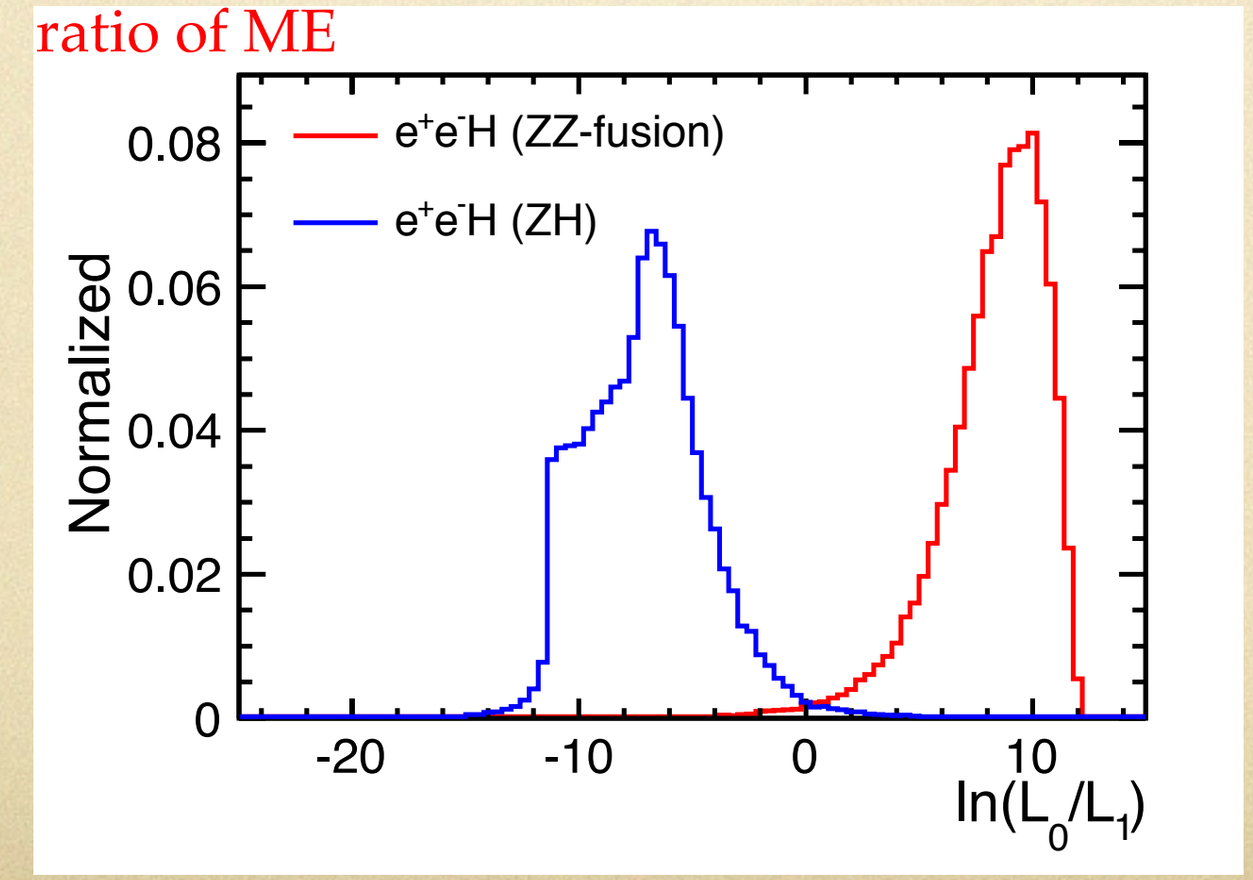
ME as from ZZ-fusion



ME as from ZH



ratio of ME



L_0: ME from ZZ-fusion

L_1: ME from ZH

(Neyman-Pearson lemma)