HIGGS PRODUCTION IN $e^+e^- \to Z° + H°$

Marvin Goldberg
Syracuse University, Syracuse, New York 13210

Summary

Higgs production in e^+e^- collision with center of mass energies above the Z° mass is discussed. A comparison is made with Higgs produced from Z° decay for a range of Higgs masses.

The primary diagram for the decay (Fig. 1)

$$Z° \to H°e^+e^- \qquad (1)$$

when rotated predicts cross sections for the reaction

$$e^+e^- \to Z° + H° \qquad (2a)$$

We will compare the two processes, noting that (1) is discussed elsewhere in these proceedings (Reference 1). For the cleanest signature we consider the chain

$$e^+e^- \to Z° + H° \qquad (2b)$$
$$\hookrightarrow e^+e^-$$

with a 3% $Z° \to e^+e^-$ branching ratio, and thereby arrive at the identical final state as in the reaction (1). As in that reaction, the electron positron effective mass, recoil mass and angle with sphericity axis will eliminate background from the reaction.

$$e^+e^- \to t+\bar{t} \to e^+e^- + X \qquad (3)$$

Here, however, the entire hadronic background is produced at rates comparable to reaction (2a) so that the cross section (3) is comparable to the cross section of (2b) without utilizing any strong kinematical cuts[1].

Table I provides the peak expected rate for reaction (2b) using the cross section[2]

$$\frac{\sigma(Z° + H°)}{\sigma(\mu^+\mu^-)} = \frac{47}{M_H(\text{GeV})} \qquad \text{(peak)}$$

and assuming an integrated yearly luminosity of 10^{38} cm^{-2}.

Note that for a given center of mass energy, the Higgs production event rate relative to $\mu^+\mu^-$ production is nearly constant for Higgs masses less than the mass indicated as the table. Figure 1 shows the cross section dependence. The event rate for reaction (1) at the same luminosity may be found in the last column of the table.

With the reduced background of (2b) compensating for the lower rates, it seems clear that (1) and (2b) are competitive up to $M_{H°}$ = 40 GeV, and (2b) has a clear advantage above this mass. Clearly, high integrated luminosities are necessary in finding the Higgs via this technique. In addition, running time at the energies indicated must be in ~ year and possibly compete with on - Z° running.

TABLE I.

$M_{H°}$	$\sqrt{s}$(GeV)	Above Z°: $e^+e^- \to Z° + H°$, $\hookrightarrow e^+e^-$ Events/Year	ON Z°: $Z° \to H°e^+e^-$ Events/Year From Ref. 1
10	104	~ 120	~ 400
20	120	~ 40	~ 90
40	148	~ 10	~ 12
60	175	~ 6	~ 1

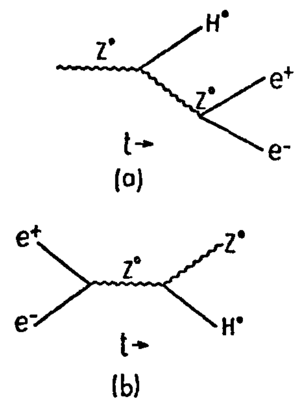

Fig. 1(a). Z° decay diagram; (b) Z° + H° production diagram.

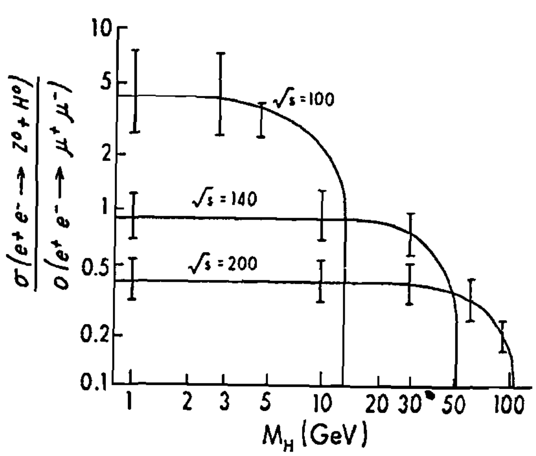

Fig. 2. The cross-section for $e^+e^- \to Z + H$ relative to the QED cross-section or $e^+e^- \to \mu^+\mu^-$ as a function of the Higgs mass and for several values of the c.m. energy. The error bars include the range of values $0.22 \lesssim \sin^2\theta_W \lesssim 0.29$.

<u>References</u>

1. M. Goldberg, Finding the Standard Higgs in Decays of Z°'s Produced in e^+e^- Collisions, Proceedings of the Elementary Particle Physics and Future Facilities Summer Study, September 1982.
2. The Production and Detection of Higgs Particles at LEP, DESY 79-27.