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

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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)

$$Z^* \rightarrow H^*e^+e^-$$

(1)

when rotated predicts cross sections for the reaction

$$e^+e^- \rightarrow Z^* + H^*$$

(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

$$e^+e^- \rightarrow Z^* + H^*$$

(2b)

with a 3% $Z^* + e^+e^-$ 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.

$$e^+e^- \rightarrow t\bar{t} + e^+e^- + X$$

(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 cuts1.

Table I provides the peak expected rate for reaction (2b) using the cross section for $H^*$ assuming an integrated yearly luminosity of $10^{36}$ cm$^{-2}$.

Table I. Above $Z^*$ ON $Z^*$

<table>
<thead>
<tr>
<th>$M_H$ (GeV)</th>
<th>$\sigma(e^+e^- \rightarrow Z^* + H^*)$</th>
<th>Events/Year</th>
<th>Events/Year From Ref. 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>104</td>
<td>~ 120</td>
<td>~ 400</td>
</tr>
<tr>
<td>20</td>
<td>120</td>
<td>~ 40</td>
<td>~ 90</td>
</tr>
<tr>
<td>40</td>
<td>148</td>
<td>~ 10</td>
<td>~ 12</td>
</tr>
<tr>
<td>60</td>
<td>175</td>
<td>~ 6</td>
<td>~ 1</td>
</tr>
</tbody>
</table>

Note that for a given center of mass energy, the Higgs production event rate relative to $\nu^+\nu^-$ 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-ZO running.
References


2. The Production and Detection of Higgs Particles at LEP, DESY 79-27.