

Observability of a Higgs signal in $e^+e^- \rightarrow \mu^+\mu^-b\bar{b}$ events

Brief description

The aim of this project is to investigate the observability of a Higgs particle signal in high-energy electron-positron collisions, in $\mu^+\mu^-b\bar{b}$ events.

For **Phase I** of this project, the student will write a Monte Carlo (MC) program to simulate the production of a Higgs particle (H) in an electron-positron collider such as LEP2 or the projected Linear Collider: $e^+e^- \rightarrow HZ$. The main background process to Higgs production in this channel – the pair-production of Z bosons, $e^+e^- \rightarrow ZZ$ – will also be simulated. The angular distribution of the bosons produced in these two processes (see Fig. 1) is different. The MC simulation should reproduce the angular distributions correctly.

In **Phase II** of the project the student will implement the decay of the Higgs ($H \rightarrow b\bar{b}$) and Z ($Z \rightarrow \mu^+\mu^-$, $b\bar{b}$) bosons, so that $e^+e^- \rightarrow \mu^+\mu^-b\bar{b}$ events are generated. The student can then investigate if the angular information from the decay products can be used to effectively distinguish Higgs (signal) events from ZZ (background) events, in this final state.

For a more realistic simulation, the experimental resolution of a typical collider detector can be implemented by smearing the four-vectors of the final state particles.

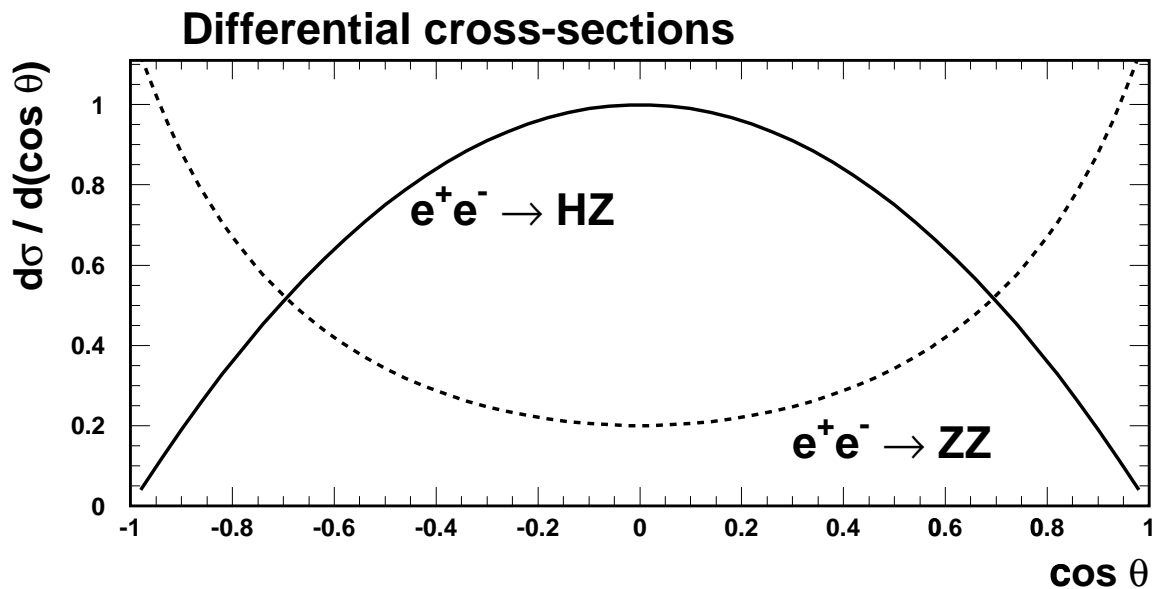


Figure 1: The differential cross-sections for the processes $e^+e^- \rightarrow HZ$ and $e^+e^- \rightarrow ZZ$, in arbitrary units. θ is the angle between the incoming electron beam and one of the outgoing particles.

Requirements

Given the strong computational character of the project, very good programming skills are essential for successful completion of the project.

(p.t.o.)

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Keywords and concepts

Monte Carlo method, acceptance-rejection method, e^+e^- collider physics, Higgs boson, experimental resolution.

References

- *Higgs bosons: intermediate mass range at e^+e^- colliders*
V. Barger, K. Cheung, A. Djouadi, B.A. Kniehl and P.M. Zerwas, Phys. Rev. **D49** (1994) 79.
- *Deconstructing angular correlations in ZH, ZZ and WW production at CERN LEP2*
G. Mahlon and S. Parke, Phys. Rev. **D58** (1998) 054015.
- *Higgs Physics*, in “Physics at LEP2”, CERN Yellow Report CERN-96-01-v-1, pp. 361-369.
- *Standard Model Processes*, in “Physics at LEP2”, CERN Yellow Report CERN-96-01-v-2, pp. 230-240.

More information on this project can be found on the web, at

<http://www.pp.rhul.ac.uk/~ptd/TEACHING/>

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