Research project

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Signal

- Signal: $e^+ e^- \to Z^* H^0 \to \mu^+ \mu^- H^0$

- Recoil mass of Higgs:

$$
\begin{aligned}
m_H^2 &= (\sqrt{s} - p_{\mu^+}^0 - p_{\mu^-}^0)^2 - (\mathbf{p}_{\mu^+} + \mathbf{p}_{\mu^-})^2 \\
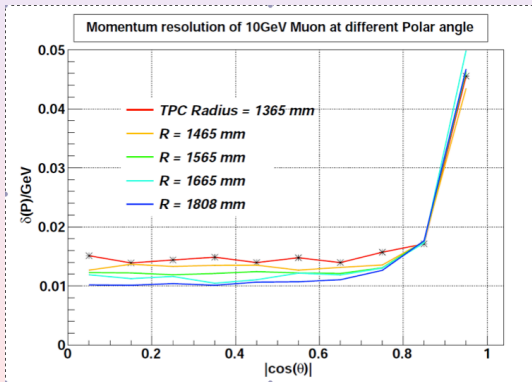&= s - 2\sqrt{s}(p_{\mu^+}^0 + p_{\mu^-}^0) + m_{\mu^+\mu^-}^2
\end{aligned}
$$

- Motivation: the influence of the Higgs recoil mass spectrum in $H\mu\mu$ final states by TPC outer radius: 1365, 1465, 1565, 1665, 1808 (default) mm.

- Backgrounds: other $\mu^+\mu^-$ final states.

$$
\begin{aligned}
e^+ e^- &\to Z\,Z \\
e^+ e^- &\to W^+ W^-
\end{aligned}
$$

Tracker resolution

• Non trivial fast simulation: with polar angle and energy dependence of tracker resolution.

• Energy: Interpolation between sample points(5, 10, 20, 40, 60, 80, 100)GeV.

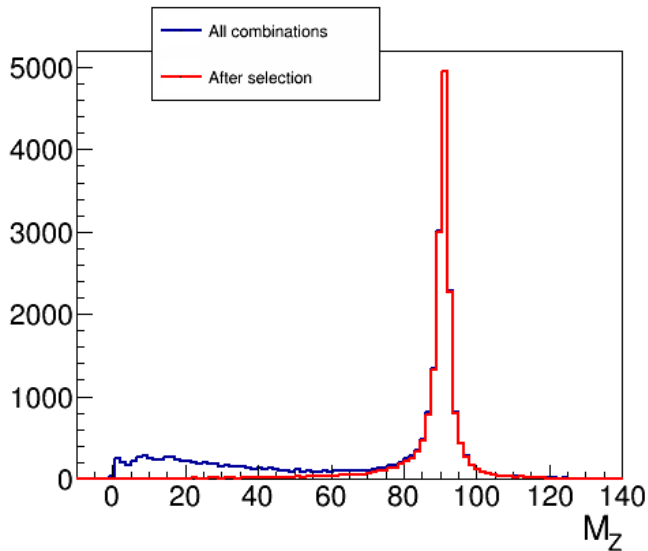• Polar angle: flat in barrel and quadratic decrease in endcap.

Sample

Information of signal sample produced by MC Simulation

- Generator: Whizard-1.95 + Pythia.
- c.m. energy $\sqrt{s}$: 250GeV.
- Luminosity: 1000fb^{-1}.
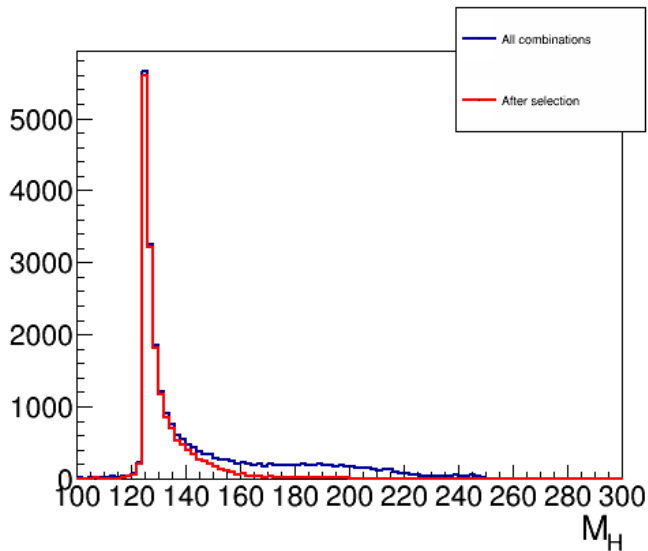- Integral: 1.7143214E+01fb.
- TPC radius: 1365 mm.

Selection of the muon pair

- Miscalculation: all possible combinations
- Choose the invariant mass of the muon pair: the closest one to m_Z.
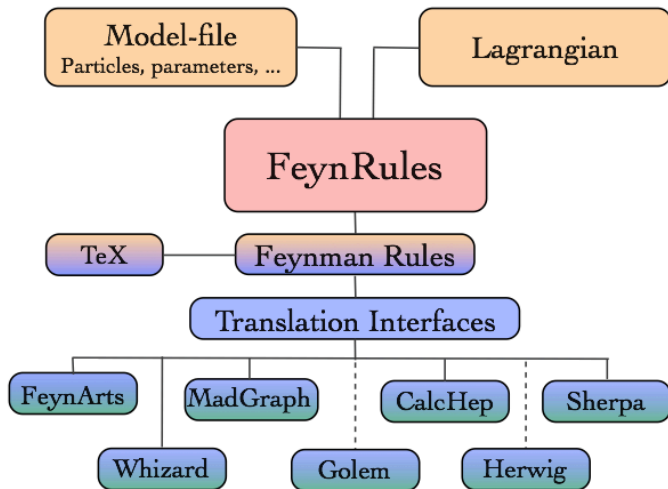
Invariant mass of Z boson

Recoil mass of Higgs boson

FeynRules

• FeynRules is a Mathematica package that allows to derive Feynman rules from a Lagrangian.

• FeynRules comes with a set of interfaces, that allow to export the Feynman rules to various matrix element generators.

• Interfaces coming with current public version.

> CalcHep / CompHep
>
> FeynArts / FormCalc
>
> MadGraph
>
> Sherpa
>
> Whizard / Omega

FeynRules

Learning plan

- C++ programming, root.

- FeynRules: BSM

    $\rightarrow$ MadGraph $\rightarrow$ ATLAS research

    $\rightarrow$ Whizard $\rightarrow$ Higgs Factory