$H \to \gamma\gamma$ Branching Ratio

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Outline

- Introduction
- Background Sources.
- Summary

Introduction

$H \to \gamma\gamma$:

- Rare decay (Br ≈ 0.003), it was not included in LOI.
- The aim of the analysis is the estimation of branching ratio precision (to be included in DBD).

- Small branching ratio: no so much events expected:

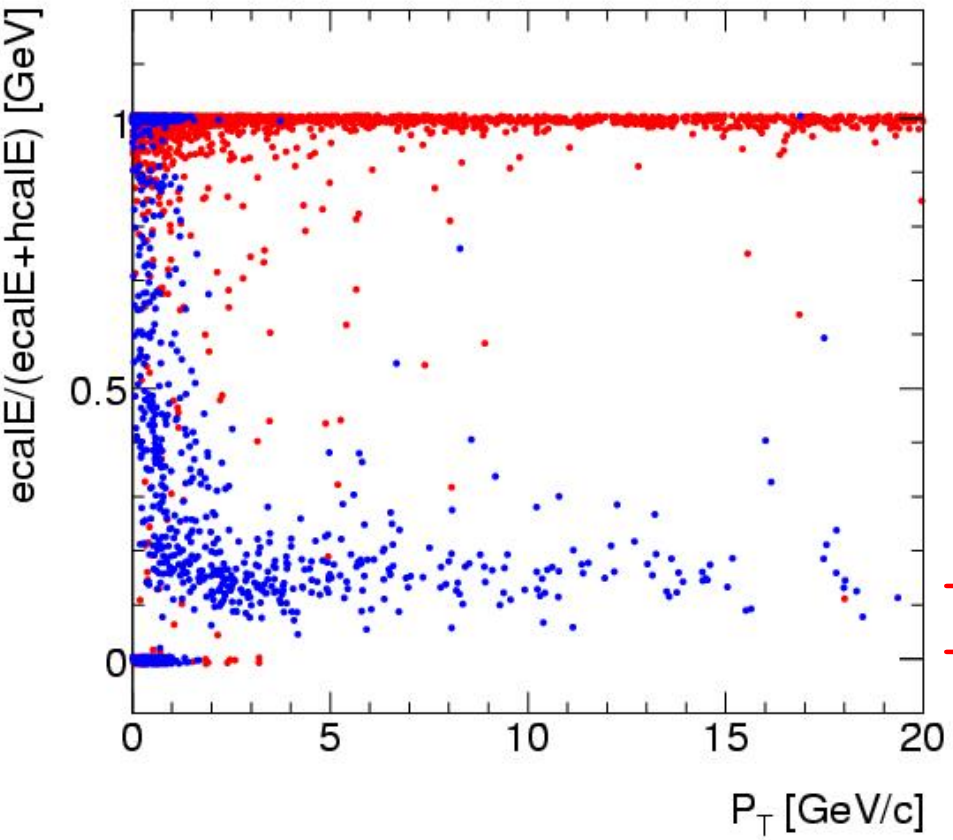
$\longrightarrow$ cross section for $e^+e^- \to ZH$ at $\sqrt{s} = 250\, GeV/c^2$:
$\sigma \approx 332\, fb$

$\longrightarrow$ Expected signal events in $L = 250$ fb^{-1}:
$N = \sigma \times L \times Br(H \to \gamma\gamma) \approx 249$

Introduction

- Produced by: $e^+e^- \rightarrow ZH$
- Three different topologies attending the Z decay:
  - $Z \rightarrow l^+l^-$
  - $Z \rightarrow q\bar{q}$
  - $Z \rightarrow \nu\bar{\nu}$
- Samples: Using the LOI samples ($\sqrt{s} = 250\, GeV/c^2$).

electron/Muon

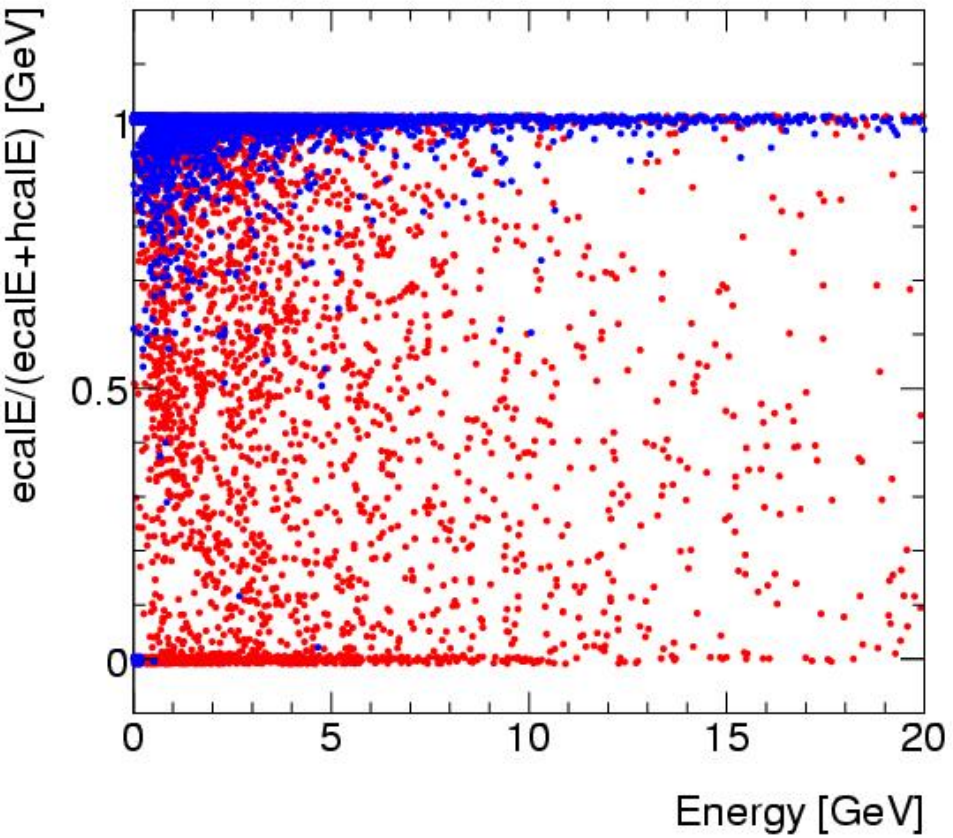


- Blue points: muons
- Red points: electrons
- polarization (e^+,e^-):(+1,-1)
- $|M(e,e) - massZ| < 30$, $|recoilM - massH| < 30$,$|M(\gamma,\gamma) - massH| < 30$

→ Muons are cluster in region < 0.5

→ Electrons concentrate around 1.

Photons



- Blue points: photons
- Red points: neutral particles (NO photons)
- polarization (e^+,e^-):(+1,-1)
- $|M(e,e) - massZ| < 30$, $|recoilM - massH| < 30$,$|M(\gamma,\gamma) - massH| < 30$

$\longrightarrow$ Photons concentrate around 1.

Background Sources

Background Sources

- Three topologies depending of the Z decay:
  - $Z \rightarrow l^+ l^-$
  - $Z \rightarrow q\bar{q}$
  - $Z \rightarrow \nu\bar{\nu}$

- In this analysis the expected signal events is low.

$\longrightarrow$ Optimization is crucial to get good background rejection.

Background Sources

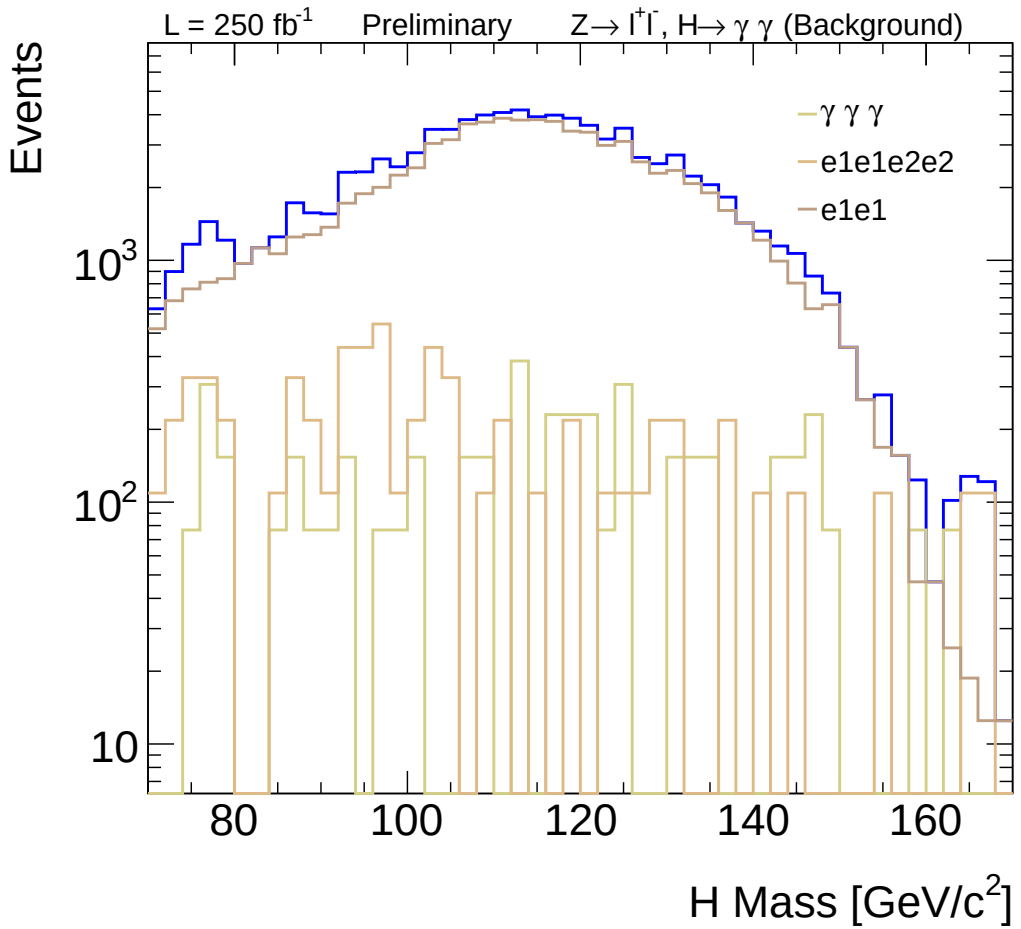
Following cuts applied:

- $|cos(\theta^*)(\gamma)| < 0.9$
- Energy inside γ cone $< 5\,GeV$
- $|cos(\theta^*)(H)| < 0.9$
- $-0.9 < cos(\gamma_1, \gamma_2) < -0.3$
- $P_t > 20\,GeV/c$

- Following plots are preliminary (No final selection yet: cuts should be optimized)

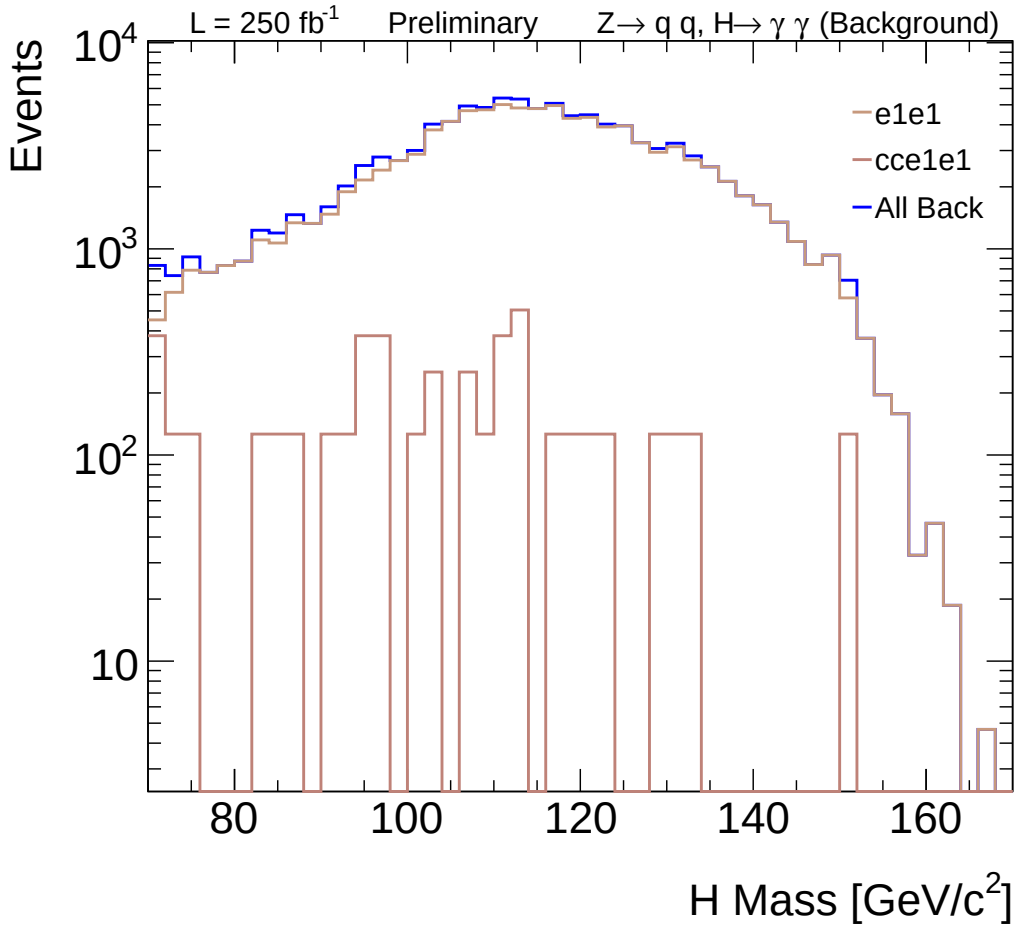
Background Sources $Z \rightarrow l^+l^-$

- Large contribution from 3 photons final states.
- No optimization of selection cuts yet.



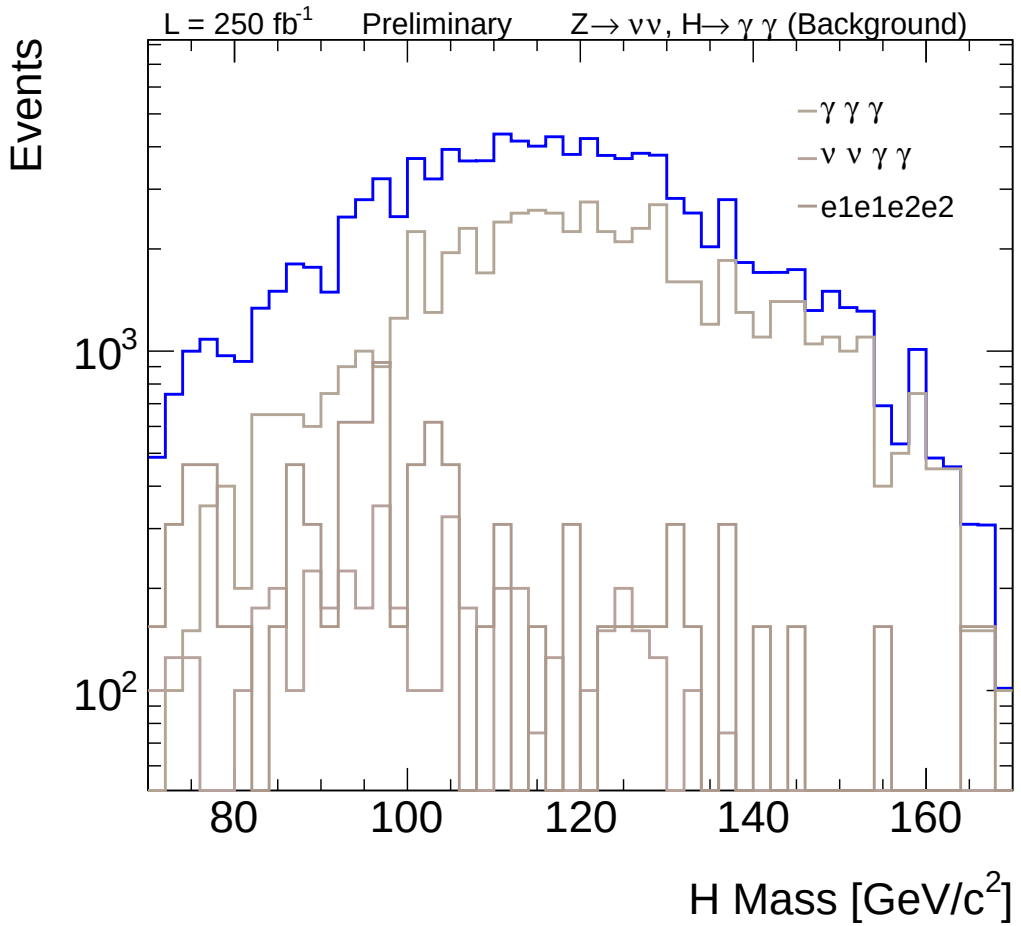
Background Sources $Z \longrightarrow qq$

- Large contribution from 2 lepton final states.
- No optimization of selection cuts yet.



Background Sources $Z \rightarrow \nu\nu$

- Large contribution from 3 photons final states.
- No optimization of selection cuts yet.



Summary

- $H \rightarrow \gamma\gamma$: Estimation of branching ratio precision for the DBD.
- Quite challenging: Small signal expected due to tiny branching ratio.

Outlook

- Optimization of the selection cuts.
- Proceed with the estimation of the branching ratio precision.