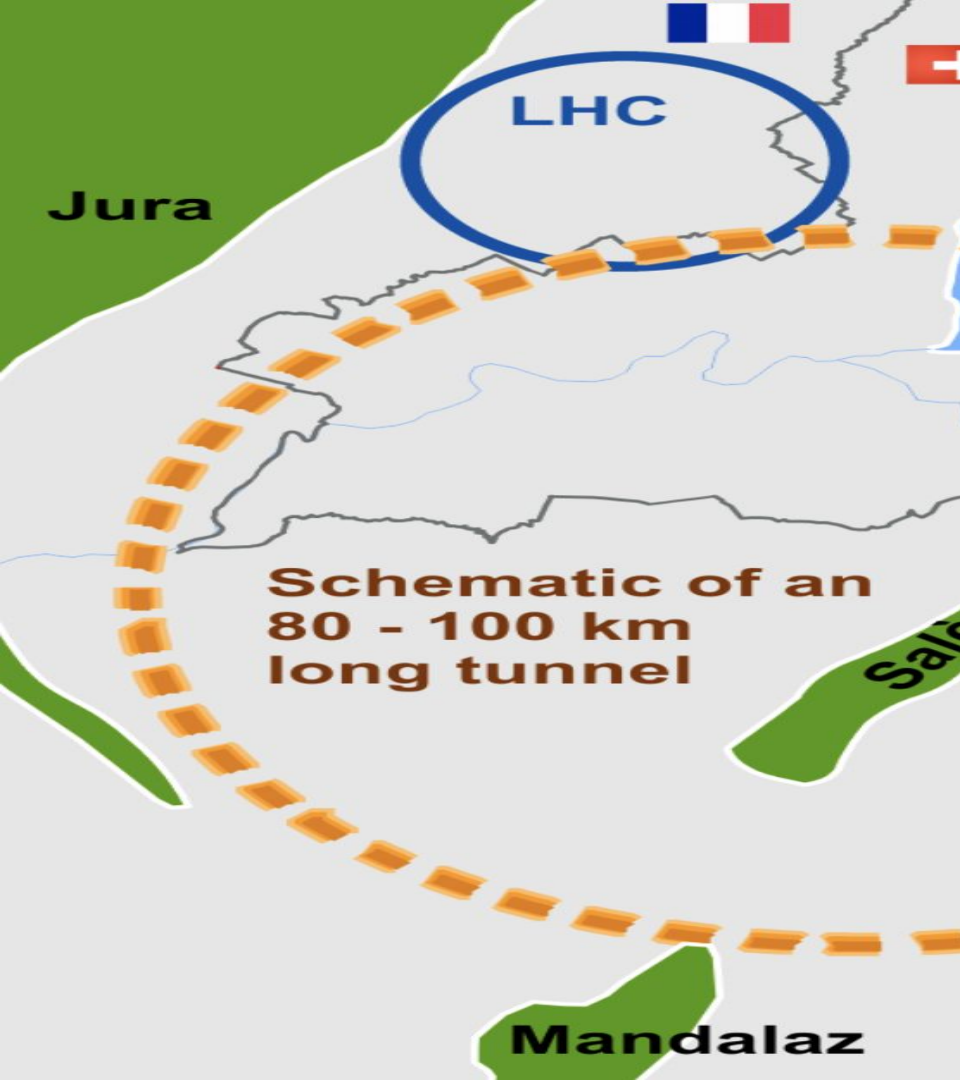


Recoil Mass Searches

FCC-ee Physics Performance Meeting
October 19th, 2020

Markus Klute - MIT

Overview

Higgs cross section (HZ)

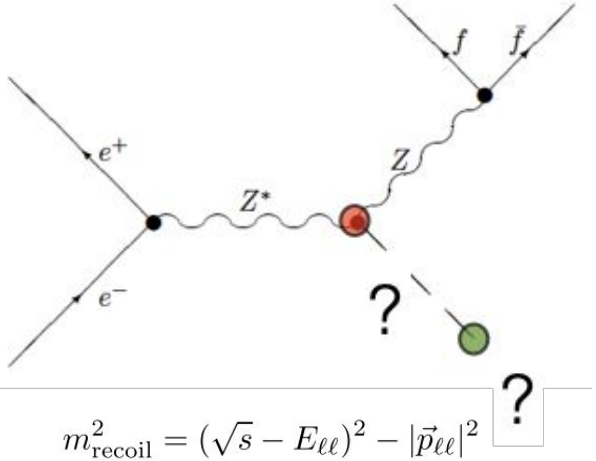
studied leptonic channel

Higgs to invisible searches

studied leptonic and hadronic channels

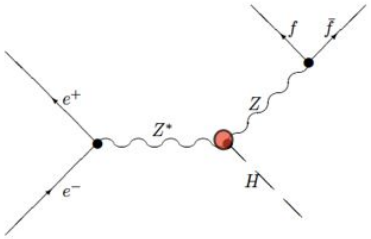
Searches for new scalars

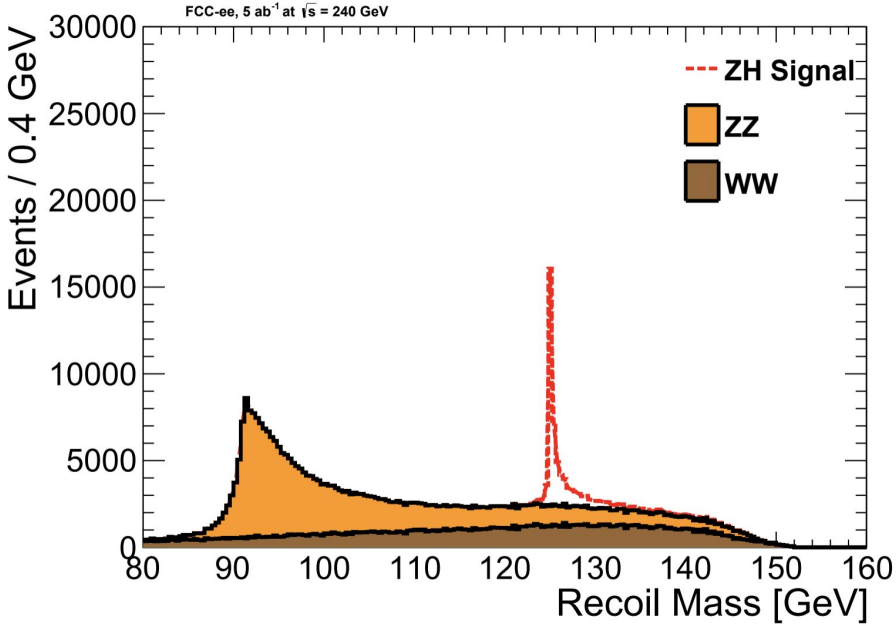
started with leptonic channel



Studies performed using Delphes and Whizard / Madgraph.

ZH Cross Section





Dominante background WW and ZZ

Main selection: Z mass, Z trans. and long. momentum, accolinearity, ...

Cross section uncertainty of 0.7% with $5ab^{-1}$ at 240 GeV

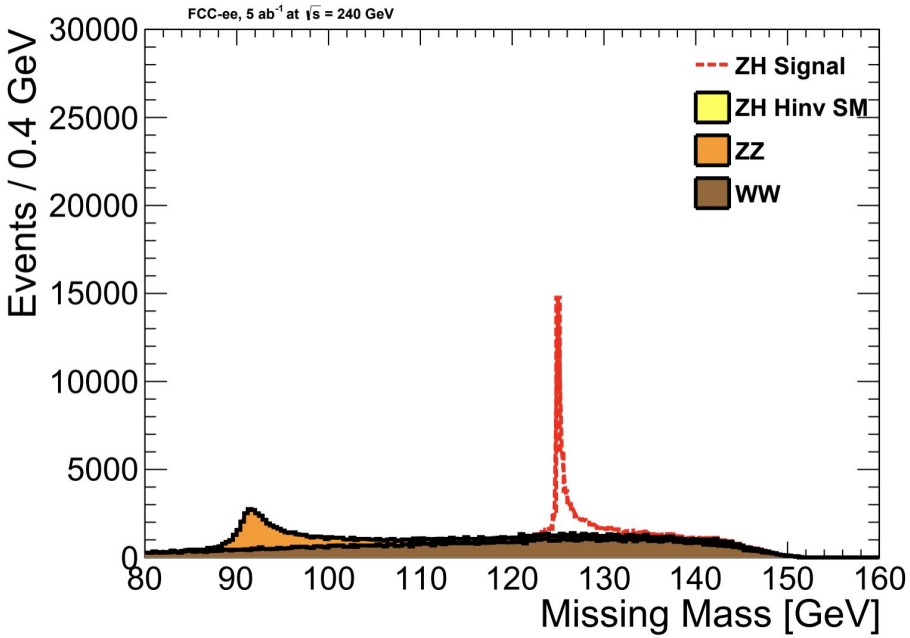
Looking at hadronic channel and adding mass measurement.

Higgs to invisible searches - leptonic channel

Dominante background WW and ZZ

Main selection: Z mass, Z trans. and long. momentum, accolinearity, veto other activity

Upper limit with $5ab^{-1}$ at 240 GeV of 0.5% on Higgs branching ratio to invisible



Also studied here
https://arxiv.org/abs/1605.00100

Higgs to invisible searches - hadronic channel

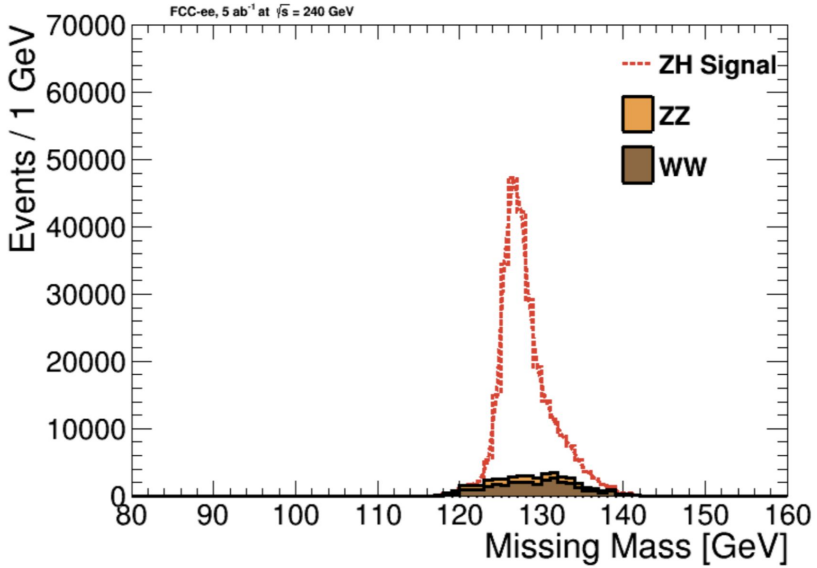
Dominante background WW and ZZ

Main selection: Z mass, lepton veto, limit add. hadronic activity

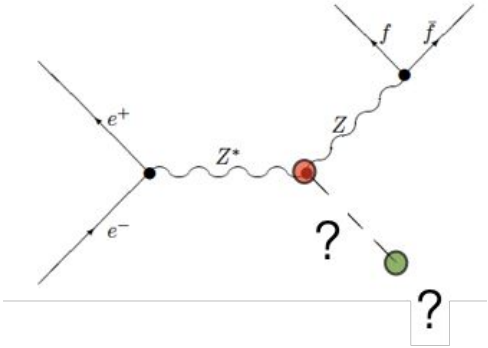
First pass demonstrates power of the hadronic channel

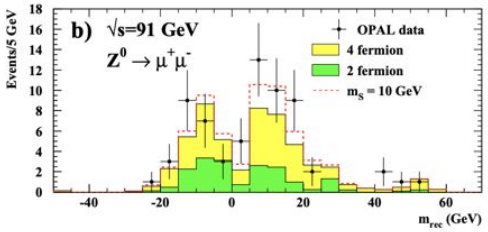
Z(vv)H(bb) sample not yet included. Can we rejected with visible mass cut.

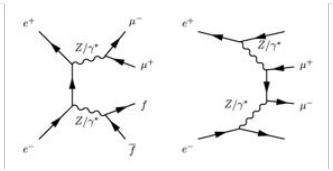
Further optimization with b-tag category, ML, ...



Searches for new scalar







Decay-mode independent searches for new scalar bosons with the OPAL detector at LEP

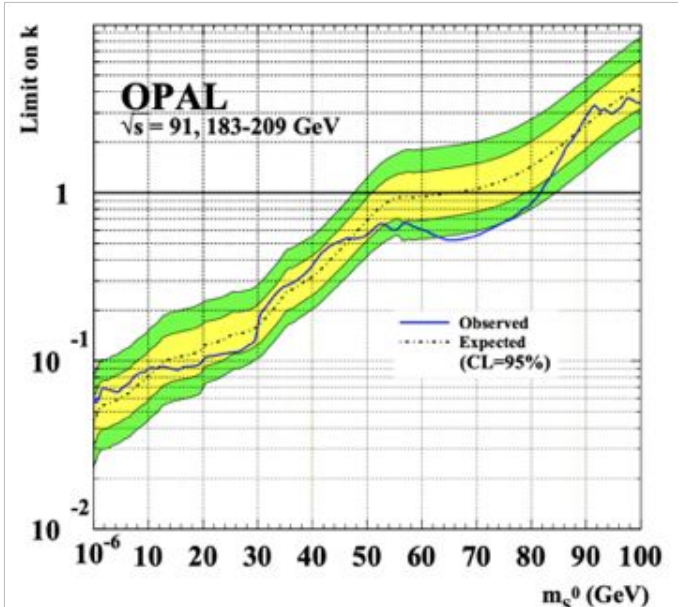
The OPAL Collaboration

Abstract

This paper describes topological searches for neutral scalar bosons S^0 produced in association with a Z^0 boson via the Bjorken process $e^+e^- \to S^0Z^0$ at centre-of-mass energies of 91 GeV and 183-209 GeV. These searches are based on studies of the recoil mass spectrum of $Z^0 \to e^+e^-$ and $\mu^+\mu^-$ events and on a search for S^0Z^0 with $Z^0 \to \nu\bar{\nu}$ and $S^0 \to e^+e^-$ or photons. They cover the decays of the S^0 into an arbitrary combination of hadrons, leptons, photons and invisible particles as well as the possibility that it might be stable.

No indication for a signal is found in the data and upper limits on the cross section of the Bjorken process are calculated. Cross-section limits are given in terms of a scale factor k with respect to the Standard Model cross section for the Higgs-strahlung process $e^+e^- \to H^0_{SM}Z^0$.

These results can be interpreted in general scenarios independently of the decay modes of the S^0. The examples considered here are the production of a single new scalar particle with a decay width smaller than the detector mass resolution, and for the first time, two scenarios with continuous mass distributions, due to a single very broad state or several states close in mass.



Searches for new scalar

Explore complete FCC-ee dataset

Phase	Run duration (years)	Center-of-mass Energies (GeV)	Integrated Luminosity (ab^{-1})	Event Statistics
FCC-ee-Z	4	88-95	150	3×10^{12} visible Z decays
FCC-ee-W	2	158-162	12	10^8 WW events
FCC-ee-H	3	240	5	10^6 ZH events
FCC-ee-tt	5	345-365	1.5	10^6 $t\bar{t}$ events

Model independent search to be complemented by search with explicit scalar boson signatures

Conclusion

Retraining team for FCC-ee studies

Aiming to extend, document, and preserve set of FCC-ee studies.

Focus on detector qualification

Studying

- ZH cross section and mass
- Higgs to invisible (leptonic and hadronic channels)
- Scalar boson search
- Higgs to bb,cc,gg couplings (not mentioned here)