

# ZH analysis and Higgs to Hadron teams introduction

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# Main Analyzers

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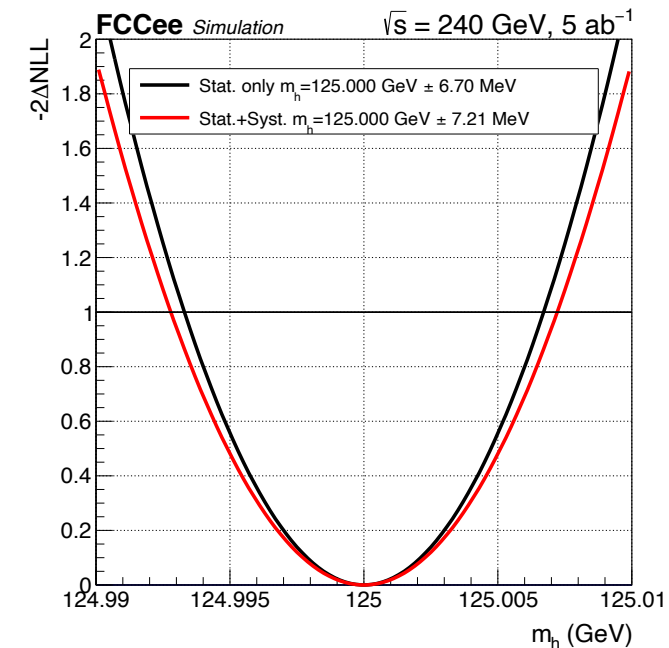


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## ➤ Higgs mass and ZH cross-section from $Z(\mu^+\mu^-)H$ events

- ✓ Event Selections (w/o MVA)
- ✓ Signal and background fits:
  - Different generators
  - Signal shapes
- ✓ Statistical analysis performed using Combine  
(Cross-section  $\sim 1.07\%$ , Higgs mass: 6.7 MeV)
- ✓ Systematics uncertainties:
  - Beam Energy Spread (samples with 1% and 6% BES uncertainty)
  - Initial State Radiation ( Whizard  $\rightarrow$  KKMC reweighting)
  - Centre-of-mass uncertainty ( $\pm 2$  MeV)
  - Muon momentum scale (variation of  $10^{-5}$ )
  - Final State Radiation (additional sample without FSR; need to benchmark against Sherpa)
  - Inclusion of all systematics (besides FSR):  $\Delta m_H \sim 7.2$  MeV and  $\Delta\sigma \sim 1.10\%$
- ✓ Further checks
  - Different detector configuration studied (Magnetic field 2T to 3T, FullSilicon tracker ( a la CLD) )
  - $M_{\text{recoil}}$  in Delphes and in Full Simulation
  - Fake Muon and muon isolation
  - Crossing Angle



This analysis is done with  
**FCCSW+RooFit+HiggsCombine**

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On behalf of the FCC-ee ZH analysis team



- Revisit Selection (with MVA)
- FSR:
  - Sherpa-to-Wizard reweighting, then implement it in the fit and check the impact
- Crossing angle:
  - implement the variation in the fit
- Muon resolution:
  - Implement smearing
  - Go directly with the resolution of the full-sim sample
- Fit studies
  - Systematic uncertainty on the background shape/norm
  - Check stat-effect of signal fits
- Model dependence study
- Backgrounds
  - 4-Fermion background generation (All Pythia backgrounds switch to Wizard)
- Electron channel
  - Smearing now identical to muons, additional smearing to be applied at analysis level
- FullSim
  - Large-stat signal samples to understand potential reco-effects
- Additional cuts to optimize fits on the mass measurement
  - E.g. remove FSR photons (or FSR recovery)
- Gen-based fit
  - Run the analysis with gen-info only, as ultimate precision reference (stat-only)
- 365 GeV pole + combination with 240 GeV
- Paper

➤ **Measurement of hadronic Higgs boson branching ratios at FCC-ee with Z(II)H events at  $\sqrt{s}=240$  GeV (Giovanni, Paul Paquiez\* and Mariette Jolly\*)**

- ✓ Flavour tagging
- ✓ Event selection, categorisation
- ✓ Fits

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➤ **Plans (Giovanni and Alexis)**

- Optimise selection and categorisation
- Compare jet flavour matching and reconstruction algorithms
- Investigate other event generators and more backgrounds
- Investigate impact of alternative detector designs (and of new algorithms) affecting flavour tagging
- Systematic uncertainties
- Fit (binned vs unbinned / range / signal model parameters that can / can't be correlated across categories / Asimov ..)
- Improve hadronic mass resolution to improve discrimination between signal and background

(\* ) former student of Giovanni