Abstract
Measurements of differential production cross sections of the Higgs boson in pp collisions at √s = 13 TeV are performed using events where the Higgs boson decays into a pair of W bosons which subsequently decay into an electron, a muon, and a pair of neutrinos. The analysis is based on data collected by the CMS detector at the LHC in 2016, 2017, and 2018, and corresponds to an integrated luminosity of 137 fb−1. Production cross sections with respect to the transverse momentum of the Higgs boson and the number of hadronic jets are considered. Higgs boson signal spectra are extracted and simultaneously unfolded to correct for selection efficiency and resolution effects by means of maximum likelihood fits to the observed event distributions.

Motivation & Introduction
- H → WW has large branching fraction. Ideal for:
  - Precision measurement of Higgs production cross section
  - Studying subleading production modes
  - Different flavor leptonic decay of W is cleanest channel
- High precision theoretical predictions of differential cross sections allow for:
  - Probing higher order corrections
  - Deviations from the SM
  - Cross section w.r.t. transverse momentum of Higgs is sensitive to Yukawa couplings of light quarks

Analysis Strategy
- Signal region events binned by observed p_T^H or N_Jet
- m_H and m_l^+l^- discriminate well against background processes
- Fit using 2D (m_H, m_l^+l^-) distributions
- Number of signal events from each generator level bin extracted from this fit
- Control regions for τ± pair production and Drell-Yan τ lepton pair production included in fit
- Unfolding, regularization and signal extraction done simultaneously in the fit

Unfolding & Signal Extraction:
- The cross sections are determined from the simultaneous fit to all bins and categories of the signal events and two control regions, which gives the signal strength modifiers.
- Since initial normalizations of the signal templates are set to SM expectations, the scale factor extracted from the fit on the generator-level bins can be interpreted at their signal strength modifiers:
  \[ \frac{\mu_{SM}}{\mu} = \frac{N_SM}{N_S} \]
- Thus, from the signal strength modifiers the differential cross sections can be inferred.
- Most of the systematic uncertainties are taken as nuisance parameters in the fit.

Main systematic uncertainties:
- Non-prompt background
- WW background
- Residual p_T^H uncertainties
- Lepton ID Efficiency Scale Factors

Selection
- Binned by p_T^H or N_Jet and categorized by lepton properties

Results

Observations

References