Update: Trilinear reweighting

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Recap

- Maltoni: determine λ_3 via single-Higgs differential measurements.
- Comparing LO to $\mathcal{O}(\lambda_3)$, observing effect of λ_3 on differential dist (e.g. $p_T(H)$). Using code by authors of arXiv:1709.08649 to generate event w/ and w/o trilinear reweighting (inclusion of electroweak loops).

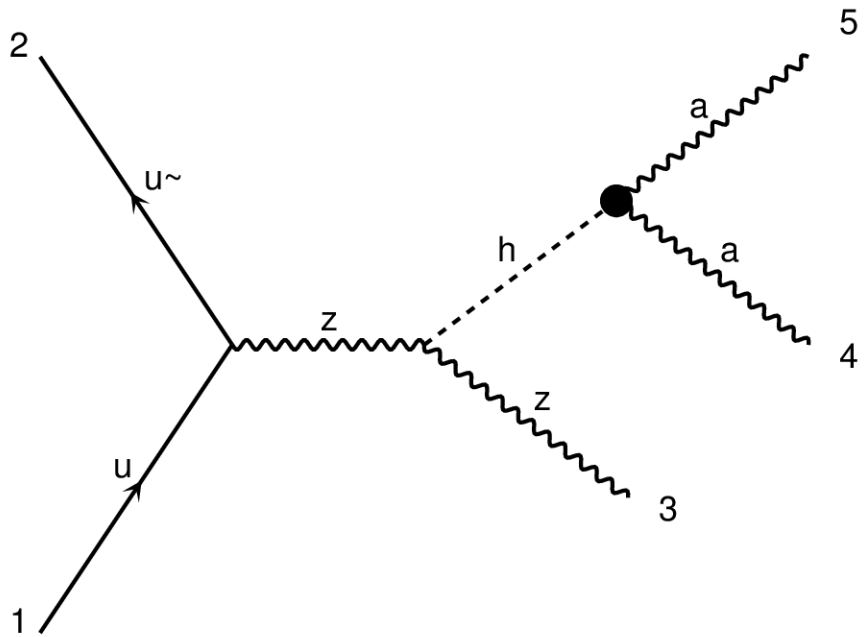


diagram 1 HIW=1, QCD=0, QED=2

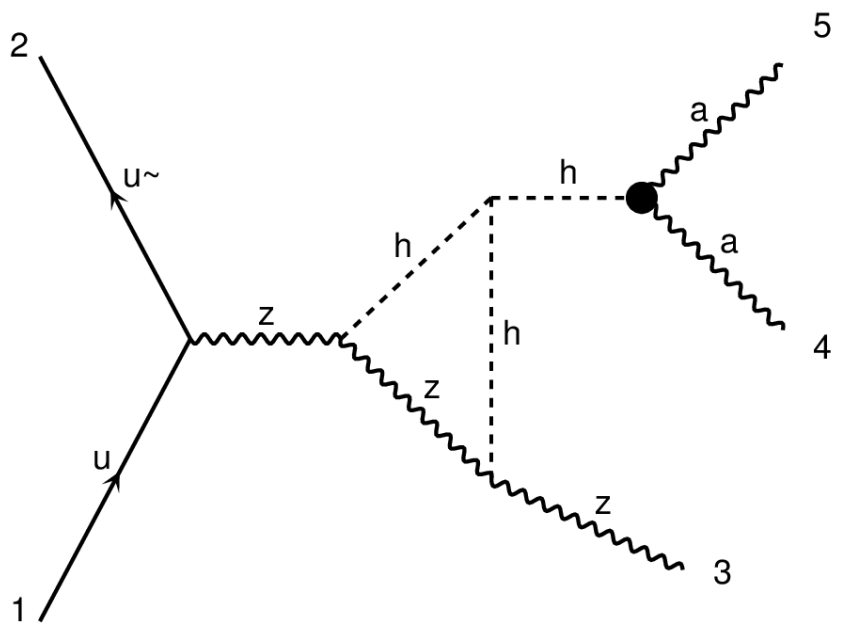


diagram 1 HIW=1, QCD=0, QED=4

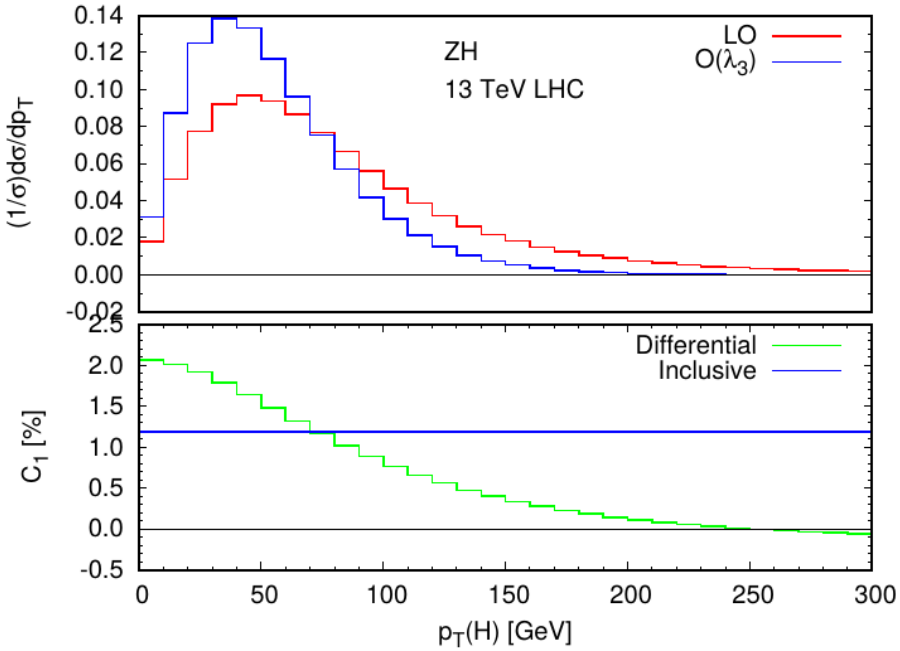
C_1 variable

- POI is C_1
  - Introduces process/kinematic dependence of λ_3 on some cross section.
  - What we extract from reweighting code
  - Ratio $\mathcal{O}(\lambda_3)$/LO in some bin of differential distribution.

$$\lambda_3 = \kappa_\lambda \lambda_3^{\mathrm{SM}}$$

$$\Sigma_{\mathrm{NLO}}/\Sigma_{\mathrm{LO}} = Z_H(1 + \kappa_\lambda C_1)$$

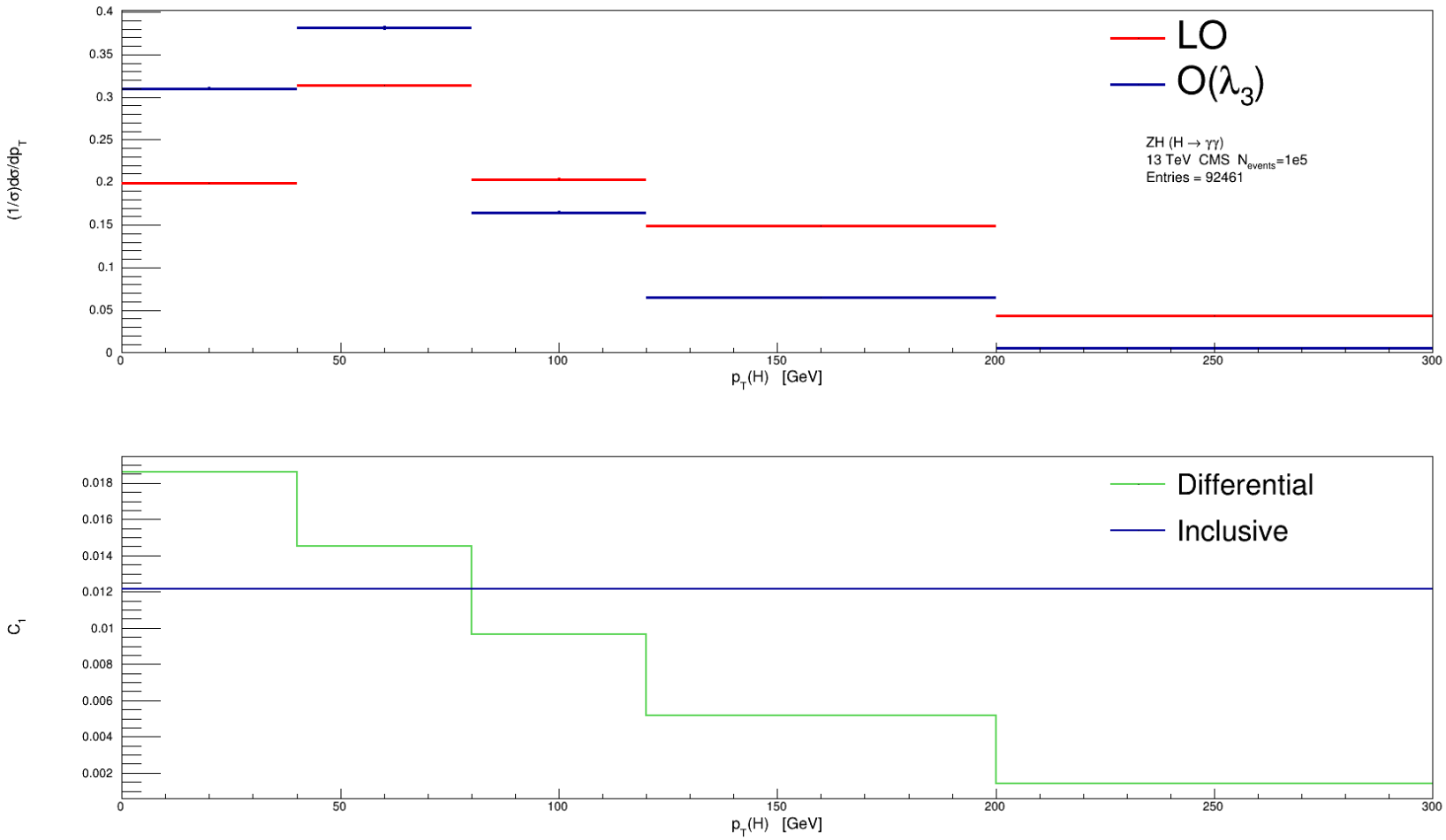
- Since: $\mu_i = f_i(C_1 i, \kappa_\lambda)$
  - $m_{\gamma\gamma}$ distribution in each bin from full signal and background MC samples
  - Use trilinear reweighting code to calculate C_1 in bin
  - Fit using combine tool to extract κ_λ



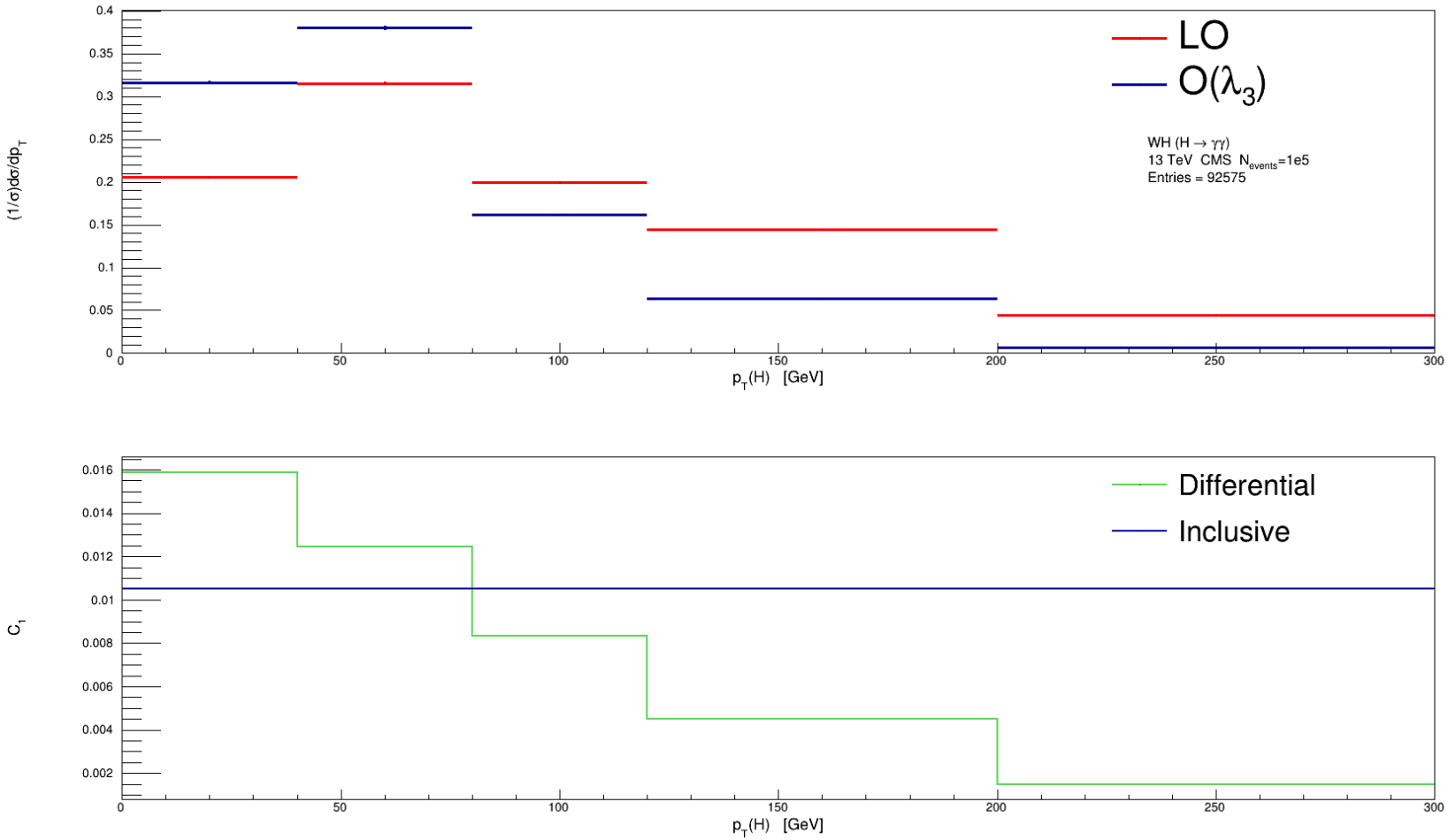
Event Gen.

- Generated events (Madgraph $\rightarrow$ PYTHIA $\rightarrow$ DELPHES) with and without trilinear reweighting (10^5).
  - ZH and WH ($H \rightarrow \gamma\gamma$ inc. in ME calc in Madgraph)
  - VBF (Issue with Madgraph, force $H \rightarrow \gamma\gamma$ in PYTHIA config).
  - Having problems with ttH in generating loop diagrams. In contact with authors of code.
- Using Generator level particles for analysis. Apply selection to extract photon pair from Higgs decay.
  - p_T of each $\gamma > 25$ GeV
  - If multiple pairs remaining, choose pair with highest vector sum p_T.
- Use large binning in distributions, statistically limited.

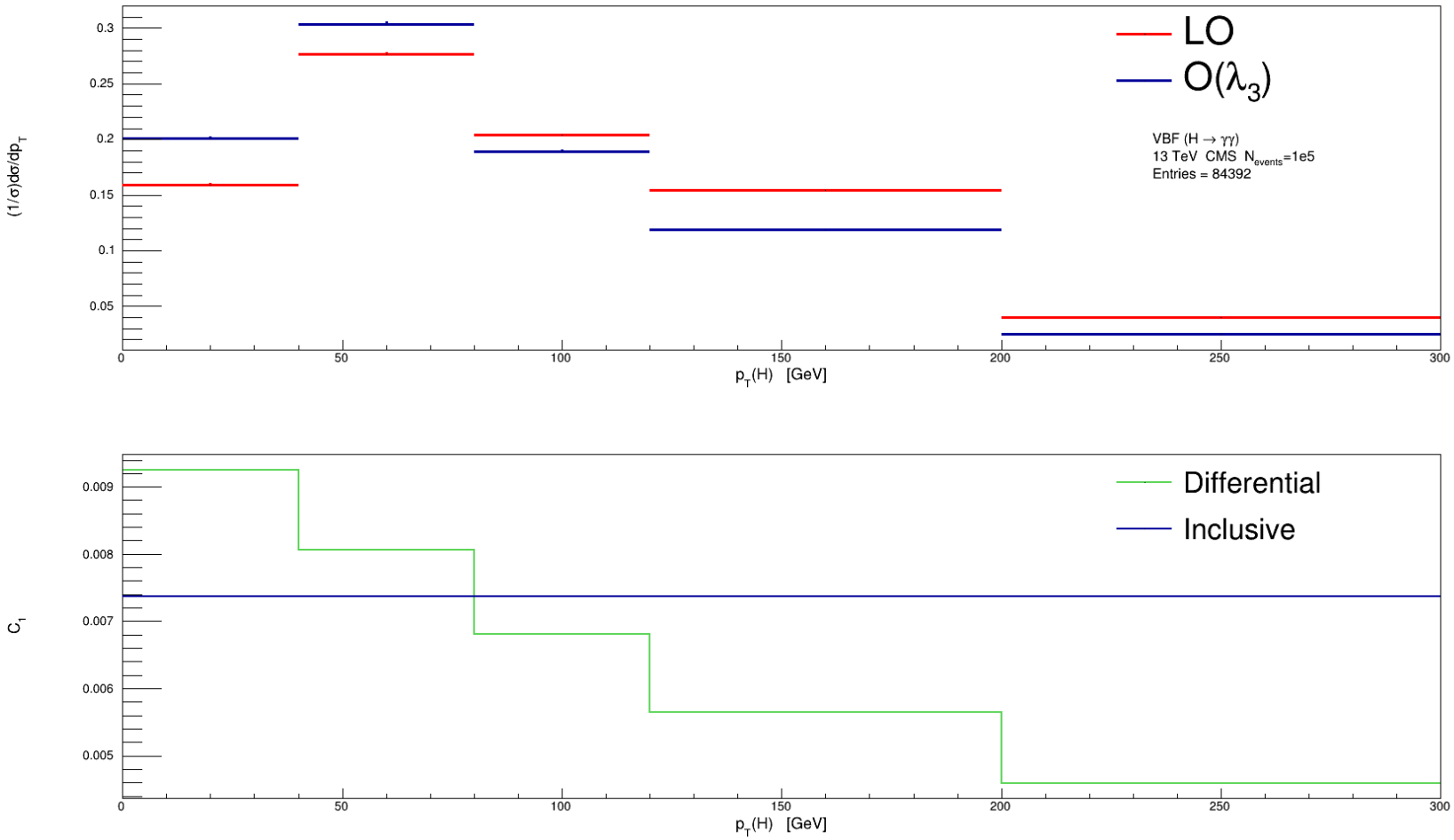
ZH Production: $p_T(H)$



WH Production: $p_T(H)$



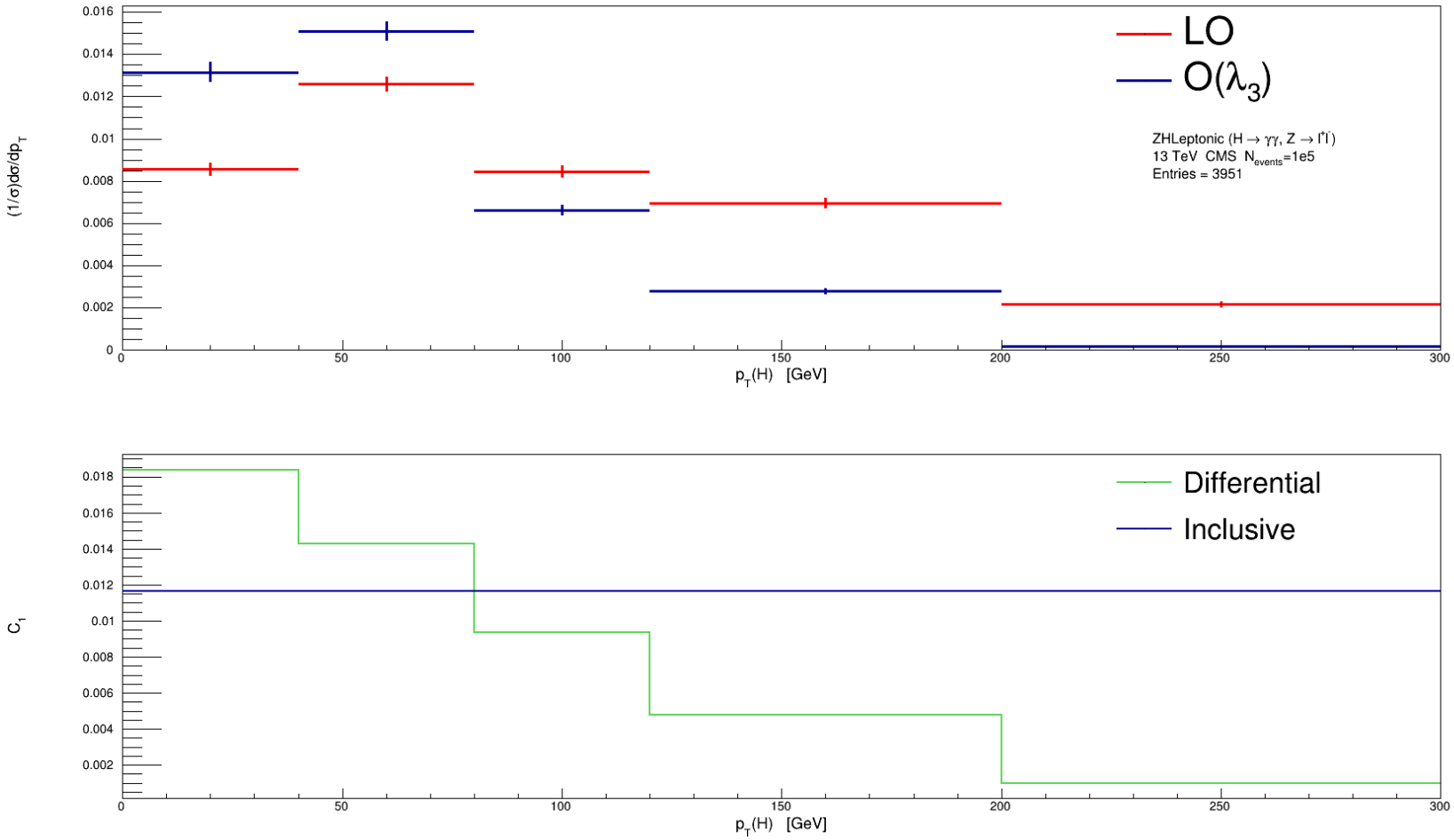
VBF: $p_T(H)$


LO
O(λ3)
VBF (H → γγ)
13 TeV CMS Nevents=1e5
Entries = 84392
(1/σ)dσ/dpT
pT(H) [GeV]
Differential
Inclusive
C1
pT(H) [GeV]

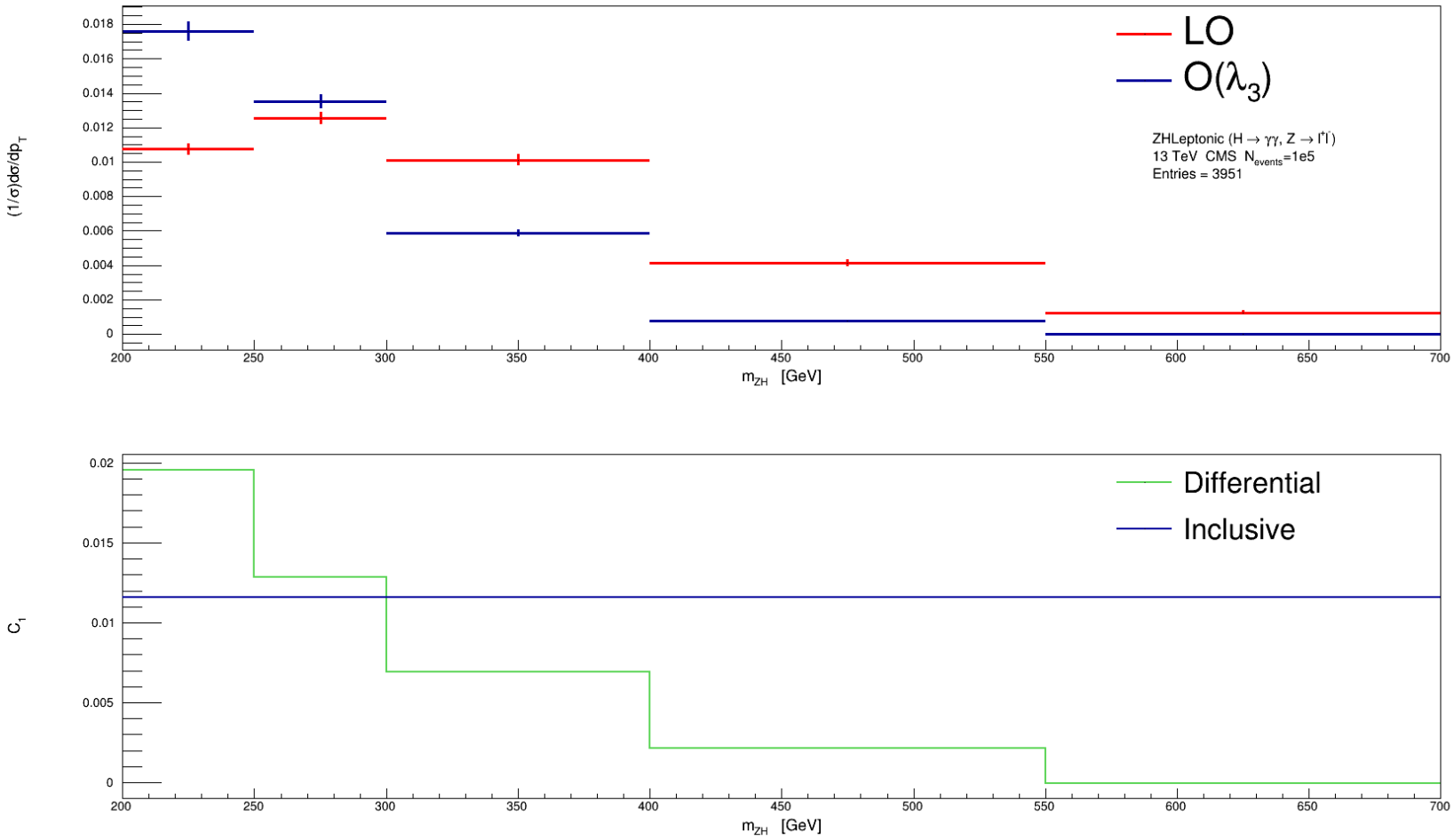
ZHLeptonic

- Moving towards real analysis categories: ZHLeptonicTag
  - $p_T(l) > 20$ GeV
  - Isolation from photon candidates: $\Delta R > 1.0/0.5$ for electron/muon
  - Same flavour, opposite charge
  - $70 < m_{ll} < 110$ GeV
  - Roughly 4% of events remaining from inclusive ZH event gen.

ZHLeptonic: $p_T(H)$



ZHLeptonic: m_{ZH}



Plans

- Now can measure C_1 in bins of any distribution.
- **Aim**: Set up full analysis framework in ZHLeptonic.
  - Using flashgg::ZHLeptonicTag on LHC official samples (signal+background). Changing configuration to dump required variables (i.e $p_T(\gamma\gamma)$, $m_{\gamma\gamma}$). Note, MC does not include trilinear effects (i.e. LO).
  - Create Asimov toy dataset, scaling up 3000 fb^{-1}
  - Make $m_{\gamma\gamma}$ distribution in each bin of distribution.
  - **Combine:** Likelihood scan to extract κ_λ: $\mu_i = f_i(C_{1i}, \kappa_\lambda)$.
  - Gives an idea of required sensitivity for this kind of analysis.
  - Will move on to HL-LHC Delphes samples when they have been made.