Status and Plans for VBF MVA Analysis

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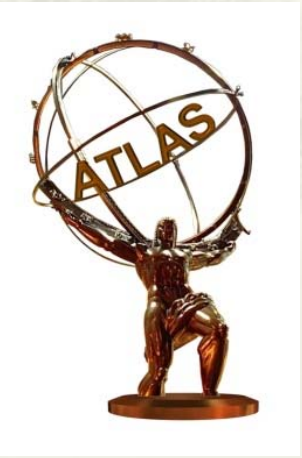
On behalf of VBF MVA contributors

2013-10-24, HSG1 Meeting

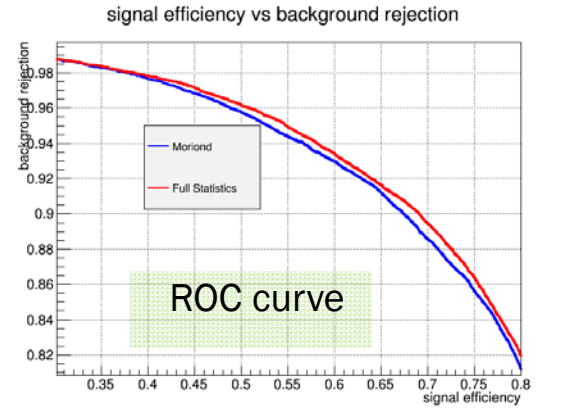


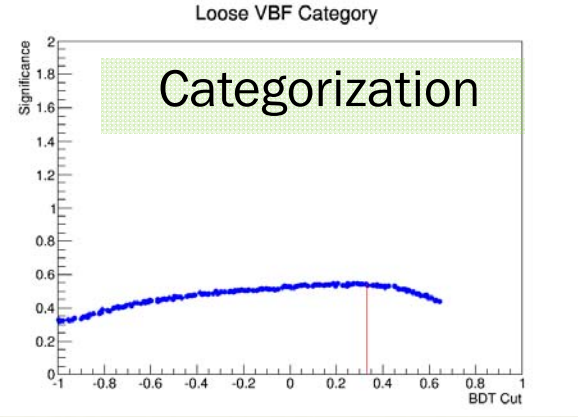
Samples and Twiki

- Common ntuples for MVA analysis are available from Fuquan eos:
  - /eos/atlas/user/f/fwang/HSG1_ntuples_May30/
  - Need to update samples with new photon calibration/geometry when available
  - signal MC, 10M Sherpa γγ MC after latest AC
  - full data with luminosity 20.3 fb^{-1}
- Twiki page with detailed information (thanks to Dag and Florian)
  - https://twiki.cern.ch/twiki/bin/viewauth/AtlasProtected/HggMVAPublication2013
  - Introduction of samples and selections
  - cut flow for acceptance challenge (to be updated)
  - variable definitions in MVA
  - task list

Current Baseline Approach

- Use 8 variables: m_{jj}, $\Delta\eta_{jj}$, $\Delta R(\gamma\gamma jj)_{min}$, η^*, $\Delta\Phi_{\gamma\gamma,jj}$, p_{Tt}, η_{jet1}, η_{jet2}
- VBF MVA training, test, optimization
  - signal sample: VBF MC
  - background sample: Sherpa γγ MC + reverse isolation sidebands from data
    - normalized with 74.9% Sherpa MC and 25.1% RevISO (from inclusive analysis)
  - odd events for training
    - MVA training configuration are optimized to maximize the ROC curve integral with good overtraining test
  - even events for test/optimization
    - VBF categorization is optimized to maximize the expected VBF significance





new MVA discriminant and categorization using full statistic training are available

More Options for Potential Improvement

Current analysis is robust. We only consider introducing changes to the paper analysis that brings significant improvement without adding too much complexity.

- The choice of variables:
  - remove the eta of two jets
  - explore more potential variables
  - Sergei, Ana, Xifeng
- Background modelling
  - reweight background to mass sidebands using different variables
    - preliminary results available, will spend more time for a fine study
  - improve the background composition for VBF category
    - under investigation by the differential cross section analysis for various Njet bins
  - Jin, Olivier, Jim, Yanping
- MVA optimization and VBF categorization
  - optimize MVA configuration and VBF categorization simultaneously
  - David, Florian, Sergei
- Introducing a 3rd category for 2 jet events?
  - investigate the effects on VBF/inclusive measurement
  - proposed by Krisztian, Florian

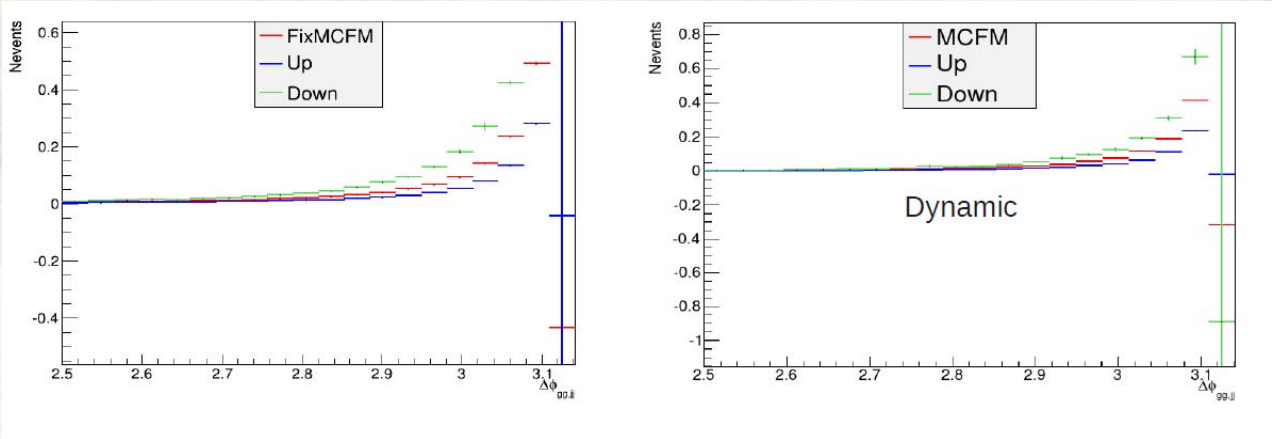
Other Tasks with Machinary Available

- Spurious Signal: Amanda, Xifeng,
- Signal extraction and resolution: Yanping, Xifeng, Jin
- Theory Systematics: Dag, Florian, Yanping
- JES/JER Systematics: Xifeng, David
- VBF scale uncertainties: Amanda, Xifeng
- Detailed cross checks as been done in Moriond: Jin, Olivier
  - variables correlation to $m_{\gamma\gamma}$
  - kinematic properties between background model and mass sidebands
  - MVA response between background model and data mass sidebands
  - $m_{\gamma\gamma}$ spectra of the data sideband and of the background model with/without MVA cut
  - Validate MVA distribution using data/MC comparison of high stat Zee+jets events
- Documentation in coupling analysis supporting note

Results could be converged quickly with fixed VBF MVA discriminant/categorization.

MCFM Scale Uncertainty Study

- From Xifeng
- Compare MCFM scale uncertainties with dynamic/fix scale
  - using MCFM ggFH+2jet parton level (NLO) with 2 & 3 partons
  - dynamic scale: $m_H^2+p_T(\gamma\gamma)^2$
  - uncertainties with fixed scale:
    - 2j inclusive: +14.3%-21.0%, 3j inclusive: +89%-44.7%
  - uncertainties with dynamic scale:
    - 2j inclusive: +12.4%-21.7%, 3j inclusive: +64.7%-42.6%



- Discuss with theorists if it is better to use dynamic scale