$H \to W^-W^+ \to l^-\bar{\nu}l^+\nu$ at DØ

Status and plans

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CEA Saclay / Irfu / SPP

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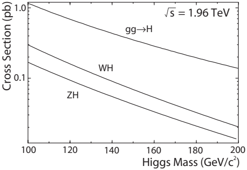
The Higgs boson and its decay channels

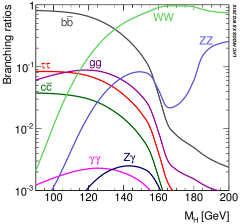
The *WW* channel is the most sensitive channel for searching the Higgs boson at DØ.

- The production cross-section increases with the *H* mass.
- The *WW* channel is dominant from around 135 GeV.

In this analysis we consider the following production modes:

- $gg \to H \to WW \to ll\nu\nu$
- $q\bar{q} \to H \to WW \to ll\nu\nu$
- Associated production: WH, ZH
- $gg \to H \to ZZ \to ll\nu\nu/lljj/llll$



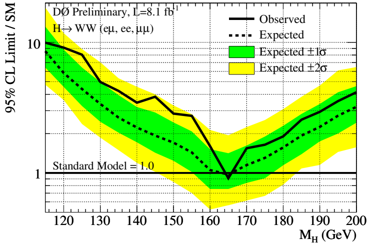


Clear experimental signature in the dilepton channel

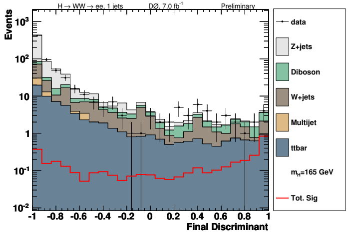
- Two high p_T, opposite charge leptons
- Missing transverse energy

Previously on $H \to WW$: Moriond 2011

- *ee*, $e\mu$ and $\mu\mu$ presented an update at this winter Moriond conference.
- This analysis alone excludes at $m_H = 165$ GeV.
- Up to 60% improvement on top of luminosity ($\sqrt{8.1/5.4}$: 22%) compared to 5.4 pb^{-1} PRL analysis.
- DØ high mass combination gives first single experiment exclusion ($m_H \notin [163, 168]$ GeV). The Tevatron combination excludes the 157 - 173 GeV mass range at 95% C.L.



Excluded cross section for all channels



Final discriminant output for the *ee* channel in the 1-jet bin

Brief overview of the analysis

- Signal signature:
  - Two high p_T, opposite charge leptons
  - Missing transverse energy
- No triggers applied to enhance the signal acceptance.
- We split into 3 jets bins (0, 1, $\geq$ 2) to increase the sensitivity (S/B is different in each jet bin).
- Higgs masses analyzed range from 115 to 200 GeV (up to 300 GeV for the fourth generation analysis) with a step of 5 GeV.
- We apply various corrections (that all preserve the normalization):
  - Luminosity
  - Beam
  - Inclusive Z p_T
  - W p_T
  - Object identification efficiency
  - Other corrections (Unclustered E_T, jet dependent Z p_T, jet η, $\Delta R(j_1 j_2)$).

Who is working on this?

Strong involvement of Saclay:

- Conveners: Aurelio JUSTE, Michael MULHEARN.
- $\mu\mu$: Davide GERBAUDO, Boris TUCHMING, Zdenek HUBACEK, Alexandre FAURÉ.
- $e\mu$: Jonas WEICHERT, Jiaming YU.
- ee: Ruchika NAYYAR, Konstantinos PETRIDIS, Aurelio JUSTE, Christophe ROYON, Émilien CHAPON.

Analysis cut flow

- Preselection: Two good quality, high p_T leptons. Technically we use the following quality criteria:

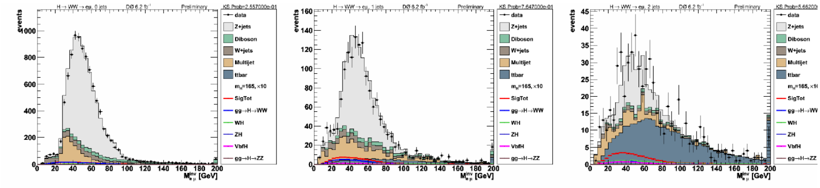
  Electrons: Point05 (CC) / Point1 (EC).
  Muons: trackloose quality for p17, newmediumtrack for p20. The isolation criteria are TopScaledMedium ($e\mu$ channel), TopScaledLoose ($\mu\mu$ p17) or TrkLoose ($\mu\mu$ p20).
  Jets: Vertex confirmed jets ($p_T < 20\,\text{GeV}$, $|\eta| \leq 2.5$).

- *ee* and $\mu\mu$: cut on the Drell-Yann BDT
  - A BDT is trained against the Z/γ^* background, which is the dominant one.
  - Different variables are used in each jet bin.
- All channels: final BDT.
  - Another BDT is trained with the final selected events, against all SM backgrounds.
  - More input variables are used to help discriminate very signal-like backgrounds.

Background estimation

- Used only RunIIb1 MC up to now (and RunIIa MC for RunIIa data). The framework has just been updated to be able to add RunIIb2 MC.
- Multi-jet background estimated from data.
- W+jets background estimated from MC, but calibrated in both *ee* and $e\mu$ channels.
  - Look at data/MC in a W+jets enriched region.
  - New method under investigation for W+jets estimation.
- A surface normalization is also applied: all MCs are scaled to data under the Z peak.
  - This is done separately in all three jet bins, and for CC-CC / CC-EC events for *ee*.

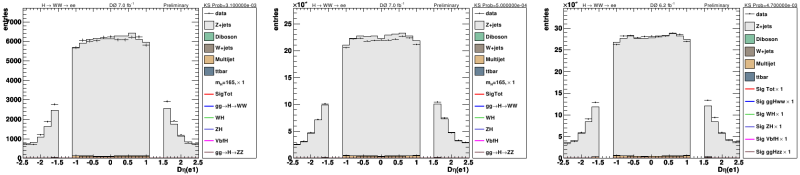
$e\mu$



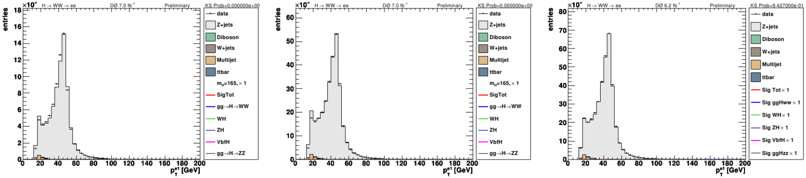
$M_{e\mu}^{\text{inv}}$ in the 0 jet, 1 jet and $\geq$ 2 jets bins, using RunIIb1,2,3 data and RunIIb1,2 MC.

- First pass of data/MC comparison and of the implementation of multiple RunIIb MC epochs in the framework.
- No big surprise for now.

ee



Detector η of the leading electron for RunIIb1 MC and data (left), RunIIb2 MC and RunIIb2-3 data (middle) and Winter 2011 setting (right).



Same plots for the p_T of the leading electron.

- Very preliminary plots.
- Investigating the issues while keeping going down the analysis flow.

Status and plans for this summer

- Goal was to publish this summer, with the following improvements:
  - Make use of Run2IIb2 MC,
  - Trigger studies and corrections for inclusive trigger (particularly $\mu\mu$),
  - Reduce fluctuations in limit coming from BDT training by increasing training statistics or averaging MVA over neighboring masses,
  - Further improve W+jets,γ understanding,
  - Include shape systematic for b-tagging,
  - Revisit jet-reweighting implementation: function parametrization, generator versus detector effects,
  - Diboson cross-section measurement to validate techniques.
- Summer conferences: not ready for today's deadline for group review for EPS.
  - We are still looking at the first data-MC comparisons (RunIIb2 MC has been added since Moriond 2011).
- We think about publishing the Winter 2011 analysis with improvements to reach publication quality.

Beyond summer 2011

- The LHC is recording good quality data very fast... This year is when the two accelerators' potential for Higgs searches meet!
- Beyond summer 2011 plans are still under discussion. We want to finish up the analysis before Moriond 2012 (for Aspen?), focusing on optimizations for low mass.
  - Use the full statistics.
  - Implement all possible improvements (such as MV electron ID for *ee*, MET correction, . . .).