

Possible Improvements for $WH \rightarrow l\nu b\bar{b}$ Search

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for WH Working Group

NN/MeBDT: B. Alvarez, A. Buzatu, F. Canelli, B. Casal, J. Cuevas, J. Dittmann, P. Dong, E. Eusebi, M. Frank, R. Hughes, C. Group, K. Lannon, S. Kim, N. Krumnac, T. Masubuchi, T. Muller, Y. Nagai, E. Palencia, A. Ruiz, J. Slaunwhite, R. Snihur, B. Stelzer, A. Taffard, R. Vilar, R. Wallny, W. Wagner, J. Wagner-kuhr, A. Warburton, B. Winer, W.-M. Yao

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b-jet Correction: T. Aaltonen, B. Kilminster, P. Methala

Tau +Jets: A. Canepa, N. Lockyer, E. Pianori,

G7 Plug: G. Chiarelli, J. Garcia, S. Leone, F. Sforza

Search for Low-Mass Higgs Boson

- Current Standard Model Higgs boson constraints
 - Experimental: $m_H > 114 \text{ GeV}/c^2$ (LEP HZ searches)
 - Theoretical: $m_H < 144 \text{ GeV}/c^2$ (global electroweak fits)
- One favorable low-mass channel is $WH \rightarrow l\nu b\bar{b}$
- Blessed Results with 2.7 fb^{-1} :
 - WH+NN: Observed limits on $\sigma \times \text{Br}$ ranged from $3.6\text{-}63 \times \text{SM}$
 - ME+DBT: Observed limits on $\sigma \times \text{Br}$ ranged from $3.52\text{-}108 \times \text{SM}$
- Strategies we focus onward:
 - Short Term for TeV combination in Oct.
 - Mid-Term for Winter Conferences 09
 - Long Term for Summer 09 and beyond.
- Also try to publish as much as we go

Short Term Improvements

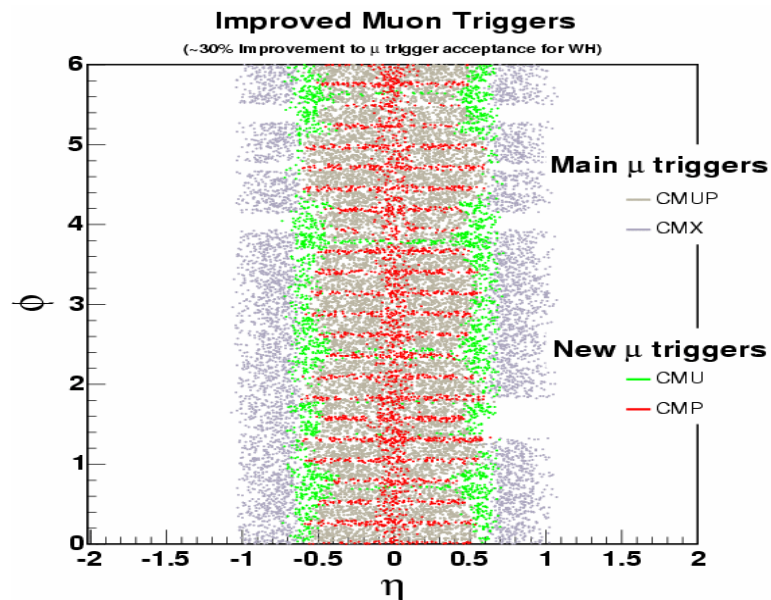
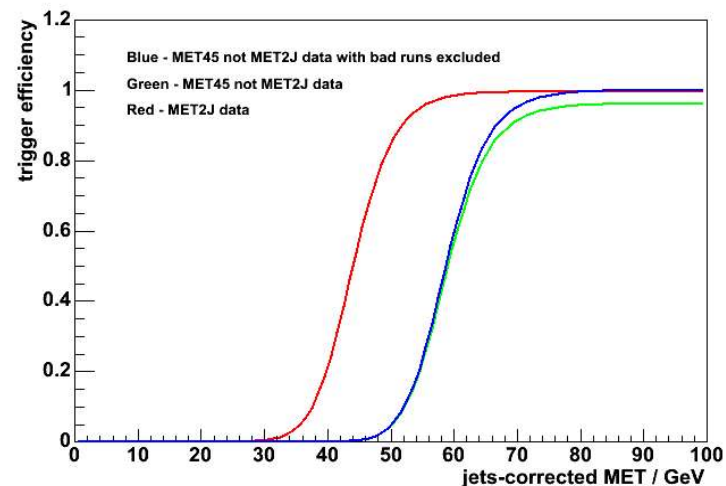
- Work to combine two blessed NN and MeBDT results together for coming TeV combination.
- Current Status: unified the event selection and common input files for data and Monte Carlo
- Optimizing search sensitivity with super discriminant using tools developed for single-top
- Trying to get MeBDT information for these isolated tracks events as well as updating the plug ele full sample for NN.
- Gain sensitivity: 5-10%

Improvements Beyond Oct.

- Trigger improvements:
- Optimizing Event Selections:
- Btagging with b-RomaNN:
- Bjet Specific Corrections:
- Optimal discriminant with NN, MeDBT, and a supper discriminant
- Search for new variables or ideas
- Improve the background modeling

Trigger Improvements

- Include Met45 trigger over MET2J: WH Isotrack ε up 19% (1b) and 11%(2b). (Adrian Buzatu)
- Investigate W no track for $W \rightarrow e \nu$
- Investigate Muon Gap triggers for $W \rightarrow \mu \nu$ (Craig Group)
- Tau + jets: L2cal upgrade improves the tau trigger eff from 70% to 90%. There might be significant overlap with Iso track events. (Elisabetta Pianori)
- Gain Acceptance: 10-15%

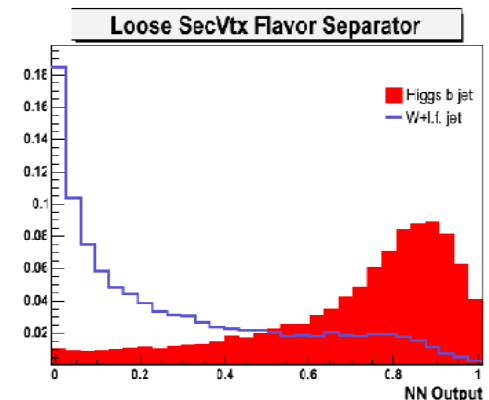
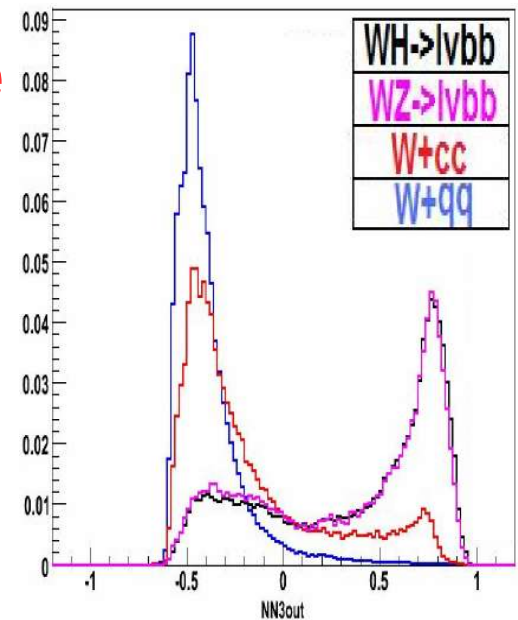


Optimizing Event Selections

- Improving Iso track selection for $W \rightarrow e \nu$ and $\tau \nu$: remove jet veto, but the key is to control background.
- There might be some gain to loose standard Lepton ID, for example, the fiducial requirement.
- The current QCD Veto is optimized for single top to minimize the systematic dependent. Reoptimizing might be a good idea for Higgs search.
- Improving plug electron with back-tracking in G7 (Pisa)
- Gain Acceptance: 10-15%

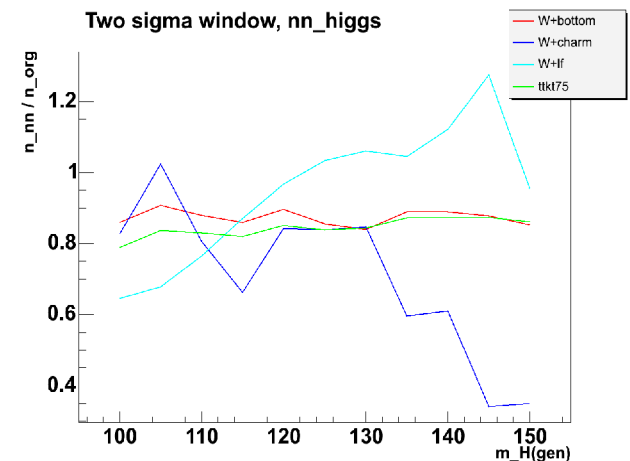
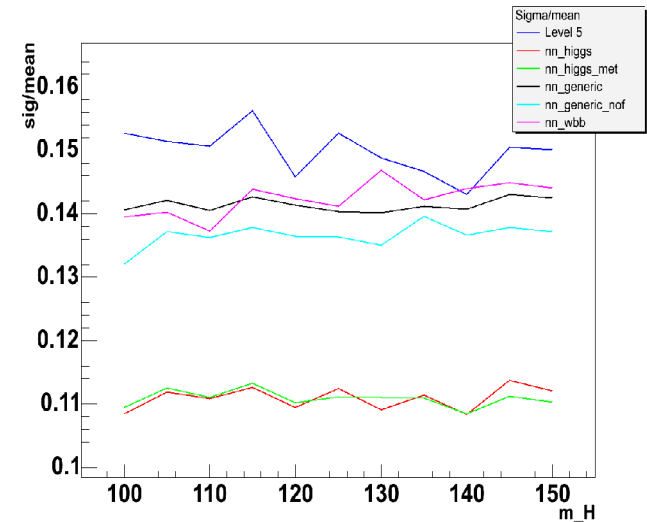
Optimizing Btagging

- b-RomaNN Btagging: increase double tags with two Roma tags (Justin Keung)
- Status: b-RomaNN SF almost ready and next is Mistag matrix
- Other Possibilities: use loose btag , but with HF separator (Brandon Parks)
- Looser JPB with 10% and SLT taggers
- Gain Sensitivity: 10-15%



Bjet Specific Correction

- Bjet correction with NN:
Great idea to train the bjet energy using NN with same set of inputs for HF separator. (Timo)
- Alternative bjet energy NN training correcting the bjet back to parton (Barbara)
- Including Soft Muon track Pt
- Gain sensitivity: 10% ?

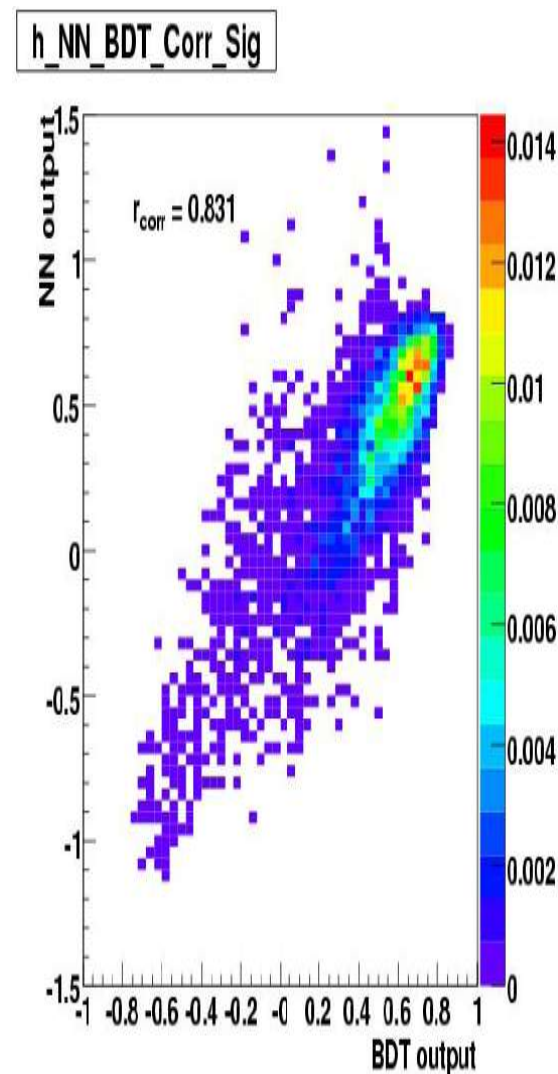


Optimal Event Discriminant

- In principle, the ME uses all the information, should be the best. Unfortunately, the jet energy, met and missing jet could degrade the performance.
- With NN or BDT training, there are some advantage to have event and other kinematic variables .
- Combining two would make the result ideal.
- Improving the TF, bjet et, btag association, neutrino reconstruction would improve the results.

Search for New Ideas

- This would be only way to make WH search successful.
- In fact, everyone is trying hard to improve WH search
- Develop a systematic way to optimal use of input variables.
- Training for single and double btags
- Correlation between NN vs DBT (Yoshikazu Nagai).
- Gain sensitivity: 10% ?



Improving Background Estimates

Based on “Method 2” W+jets background studies

W+heavy flavor (Wbb, Wcc)

- use ALPGEN HF fraction
- scale to observed W+jets
- HF calibration in jet data
- rescaling same as top group
- carries 35% rel uncert.

W+light flavor (mistag jets)

- mistag rate from jet data
- asymmetry factor 1.37 ± 0.13
- Gen6 correction 1.05 ± 0.03

Non-W QCD multijet

- fake leptons and/or fake MET
- sideband extrapolation
- MET vs Iso method
- assign 17% rel uncert

Electroweak backgrounds

- single-top production
- WW/WZ boson production
- Z decays to τ pairs
- cross sections, ID, btag SF

Conclusion

- **Short Term**: Combine NN+MeDBT into single WH result and start to work on publication with 2.7 fb⁻¹.
- **Future Improvements in 09**:
 - Trigger improvements
 - Optimizing Event Selections
 - Btagging with b-RomaNN
 - Bjet Specific Correction
 - Optimal discriminant with NN, MeDBT, or a super discriminant
 - Search for new variables or ideas
 - Improve the background modeling
- **Expected Sensitivity improvements ~1.5 for summer 09.**