

Continuing MVA Studies with ν STORM

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Overview

- 1 Summary Recent Progress
- 2 Update to Current Status
- 3 Addition of New Variables to Analysis
- 4 Systematics

Continuing TMVA Studies for ν STORM

Successful Avenues

- Changes introduced by Tapasi Ghosh
 - ▶ Simple re-organization of the MINDplotter code.
 - ▶ Needed some re-adjustment of the analysis but this is conditional now.
- Re-ran trees with apparent problems in energy correction.
- Corrected persistent bug in analysis code.
 - ▶ Made the apparent yield 150% larger.
 - ▶ Did not affect final sensitivity

Not so successful things

- Adding variables for shower discrimination does not help.
 - ▶ Tried mean number of hits per track
 - ▶ Tried Q_t .
 - ▶ Made the final results worse.

Current Status of SuperBIND

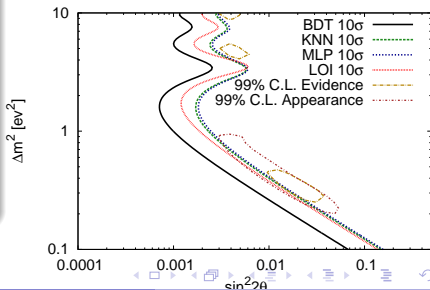
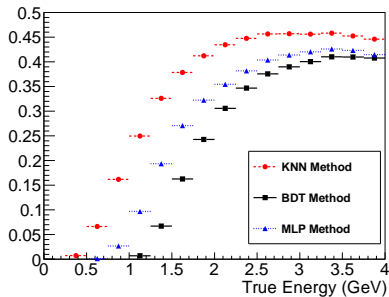
Two figures of merit

① Efficiency curves

- ▶ Increase in the energy threshold.
- ▶ A plateau in efficiency for MVA.

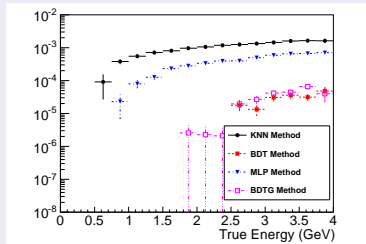
② Sensitivity contours

- ▶ Clear separation of BDT from LOI and other methods.
- ▶ 10σ coverage of important phase space with BDT
- ▶ Background rejection is paramount for this analysis.

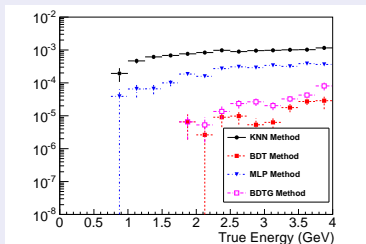


Background Rejection for Three Methods

ν_e CC Background



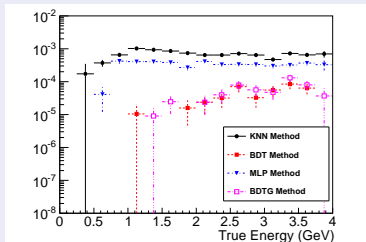
$\bar{\nu}_\mu$ NC Background



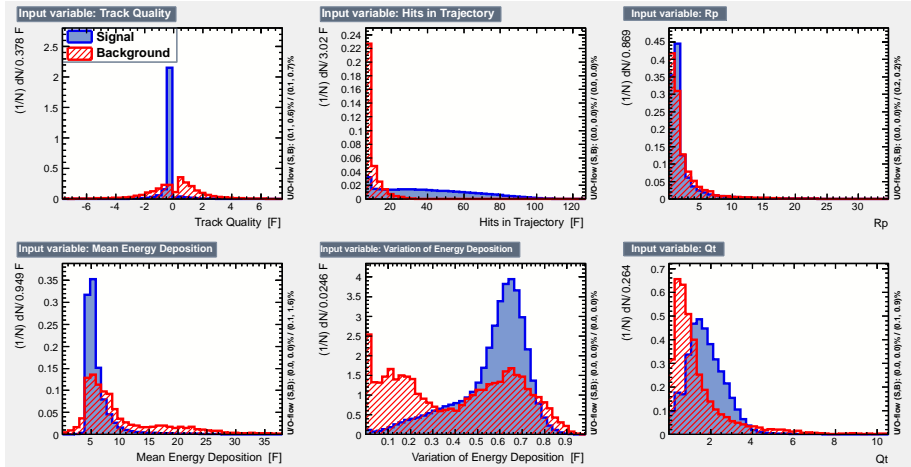
Observations

- BDT background is always less than 10^{-4} .
- MLP (neural network) is better than KNN method.
- ν_e CC and $\bar{\nu}_\mu$ NC go as $E(?)$.
- $\bar{\nu}_\mu$ CC is roughly flat.

$\bar{\nu}_\mu$ CC Background

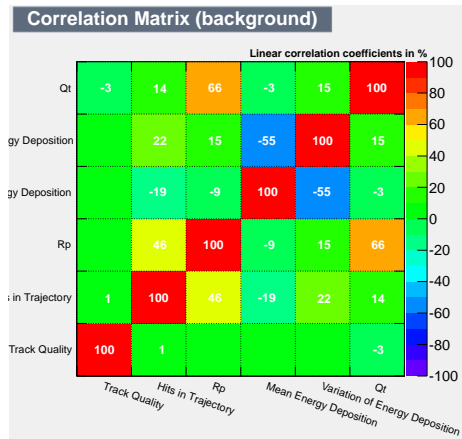
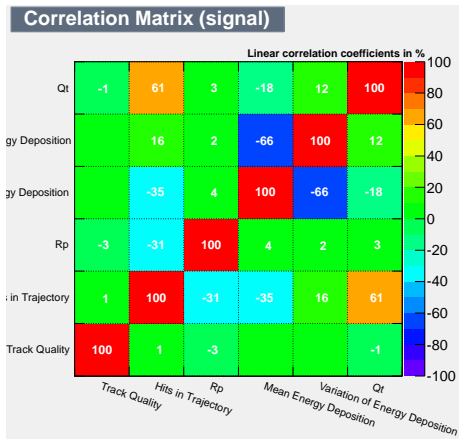


Adding Q_t variable



- $Q_t = p_\mu \sin^2 \theta_{\mu,h}$ added to analysis.
- Shows some potential as a separation variable.
- Also tried mean hits per plane but did not show clear separation.

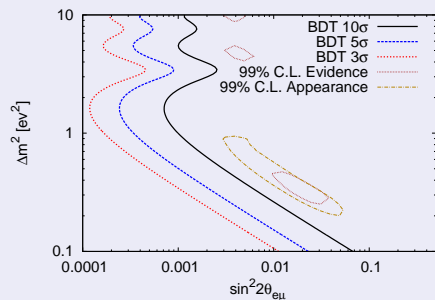
Correlations of new variable set



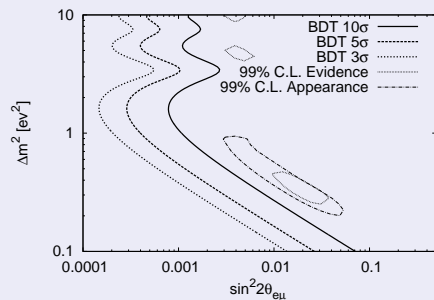
- No variables are redundant (no 100% correlations).

Sensitivities with and without Q_t

Without Q_t Variable in Analysis

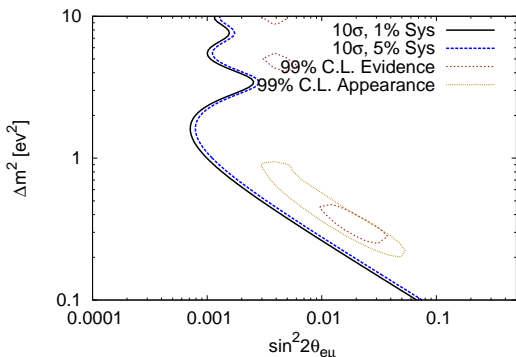


With Q_t Variable in Analysis



- Better coverage with prior analysis than analysis with Q_t .
- Coverage still more than sufficient to achieve goals.
- Q_t may give better results if it replaces R_p variable.
- As is adds nothing to analysis.

Sensitivity to Systematics



- Increased signal systematic error to 5% from 1%
- Increased background systematic error to 20% from 10%
- Results are robust to changes in the systematics.
- 5% systematic error is larger than the expected uncertainty.

Conclusions

- Some small changes have been made to the reconstruction.
 - ▶ A correction to energy loss may have affected the MVA.
 - ▶ Primarily affected ν STORM simulation.
- Updated status of analysis
 - ▶ Efficiency of MVA methods smaller but still improved over cuts analysis
 - ▶ Background of MVA methods smaller for BDT, but larger for KNN.
- Attempted addition of new parameters in analysis
 - ▶ Considered mean number of hits per plane and $Q_t = p_\mu \sin^2 \theta_{\mu,h}$.
 - ★ Mean hits per plane detrimental to analysis.
 - ★ Q_t does not improve physics results.
- Rudimentary exploration of systematics.
 - ▶ Increase of normalization systematics by factor of 5
 - ▶ Minimal impact on ability to resolve LSND anomaly.