Topological event selection for the top quark mass measurement in the lepton+jets channel

Motivation

- separate top from background without biasing top mass

➔ apart of b–tagging, the way to do this is the topological event selection.

➔ variables weakly correlated with fitted mass, provide useful discrimination between signal and background

Signal: 2K ttbar –>e+jets	**Monte Carlo**
Background: 112K W+4jets, no QCD	**RunII**

Event preselection

Electron
pT > 20 GeV
$|\eta|$ < 2

Njets >= 4
ET_jet >15 GeV
$|\eta|$<2

MET > 20 GeV

ET_W > 60 GeV
$|\eta W|$ < 2

No cuts on

Aplanarity

$$H_T = \sum_{jets} P_T$$

Put into Neural Network

Neutrino Pz and W boson reconstruction

APS

Topological variables require W boson reconstruction as a first step

$$m_W^2=(E_e+E_\nu)^2-(\vec{p}_e+\vec{p}_\nu)^2$$

$$p_\nu^{z\,12}=\frac{(M+B)\,p_e^z}{(p_e^T)^2}\left(1\pm\frac{E_e}{p_e^z}\sqrt{1-\frac{(p_\nu^T p_e^T)^2}{(M+B)^2}}\right)$$

$$p_\nu^x=MET_x$$

$$p_\nu^y=MET_y$$

$$B=p_e^x p_\nu^x+p_e^y p_\nu^y; \qquad M=\frac{m_W^2}{2} \qquad m_W-W\ boson\ mass$$

Smallest absolute value of neutrino pz gives right solution 80%
will try to optimize further

mT>mW =>scale MET

$$k=\frac{M}{p_e^T p_\nu^T-p_e^x p_\nu^x-p_e^y p_\nu^y}$$

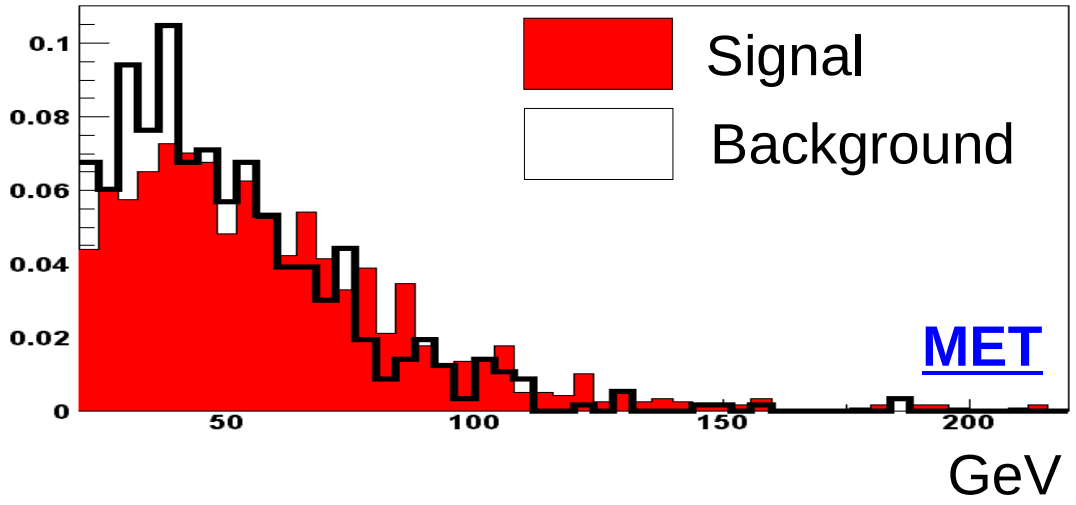
Topological variables APS

- ✔ weakly correlated with the fitted mass
- ✔ provide useful discrimination between signal & background

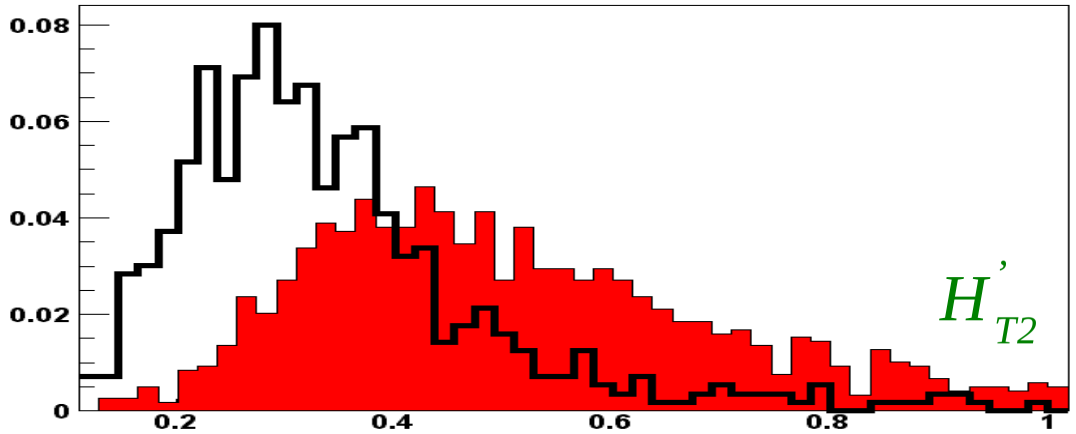
Used in Run I

MET	Missing transverse energy
A	$= \frac{3}{2} Q_1$, where Q_j is smallest eigenvalue of M_{ij}
H'_{T2}	$= H_{T2}/H_{z'}$ $H_{T2} = \sum_{jets} P_T - P_T^{highest}$, $H_z = \sum_{e+\nu+jets} \lvert P_z \rvert$
$K'_T min$	$= \frac{\delta R_{min}(ij)\, ET_{min}(ij)}{ET_W}$ using four leading jets

Topological variables APS



poor discrimination between signal and W+4 jets background (will be useful for QCD background)



good discrimination between signal and W+4 jets background

Correlations

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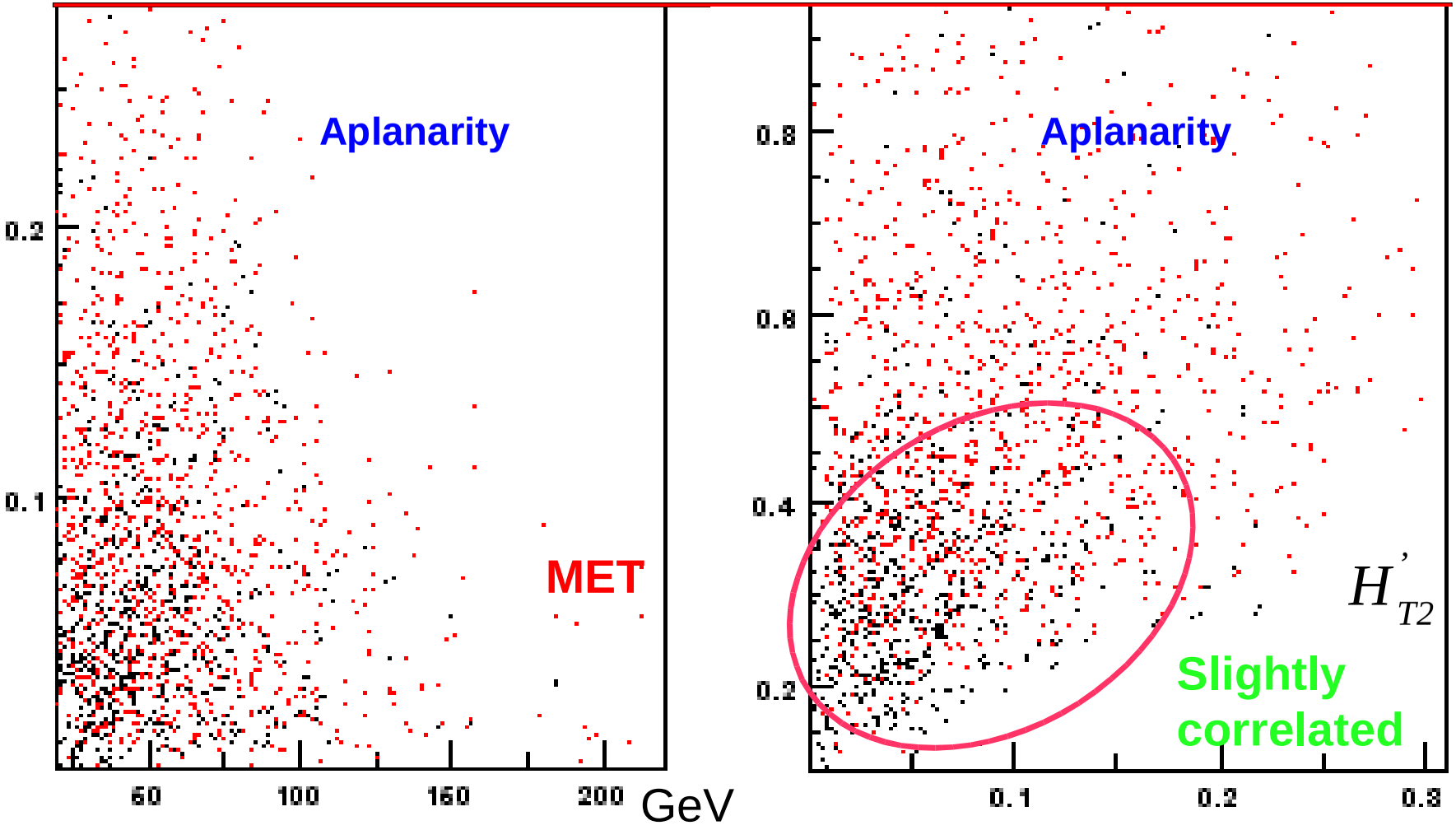

Neural Network

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- NN is used to build a discriminant variable between signal and background. The NN architecture: 4 input nodes, 8 hidden nodes, 1 output node
- The NN is trained using the back−propagation algorithm provided in JETNET program
- Training sample:
  signal: HERWIG tt MC (mt 175GeV)
  background: VECBOS W+4jets
- After proper training, the NN output approximates the Bayesian probability

$$P(s/\vec{x}) = \frac{s[\vec{x}]}{s[\vec{x}] + b[\vec{x}]},$$

$s[\vec{x}]$ −Signal probability

$b[\vec{x}]$ −Background probability

Neural Network output

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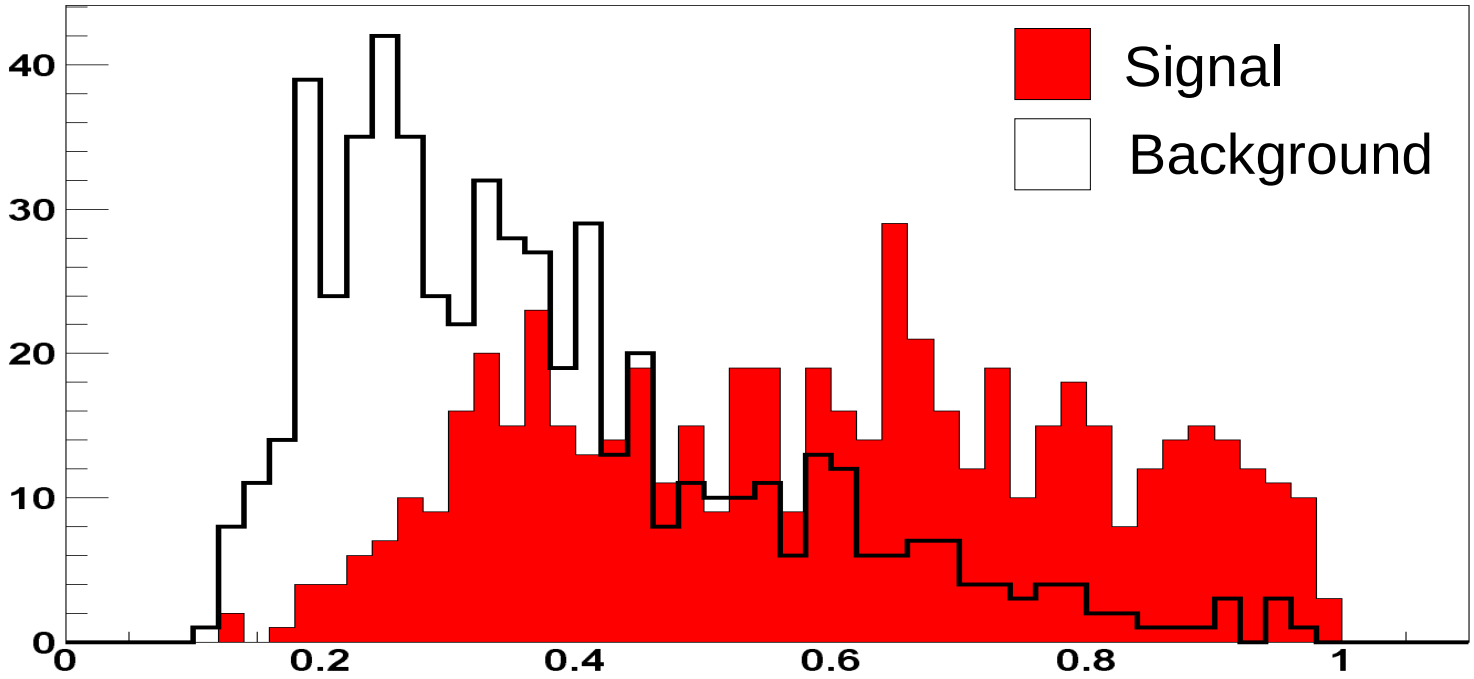

475 events for training
88 events for testing

First test with limited statistics

Summary

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➔ First look at topological selection in e+jets channel using a NN discriminant

➔ Started from Run I set of variables.
The Run I performance has not been reached yet.
Needs further investigation, possible cause is limited statistics

➔ Next steps:

- Explore new variables
- Include the QCD background
- Include more statistics for W+jet background