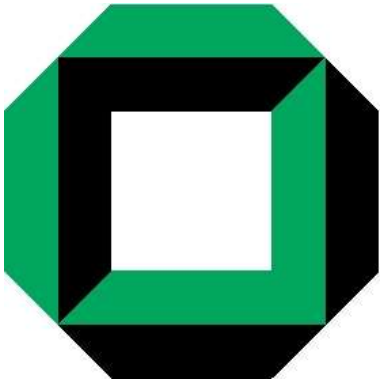
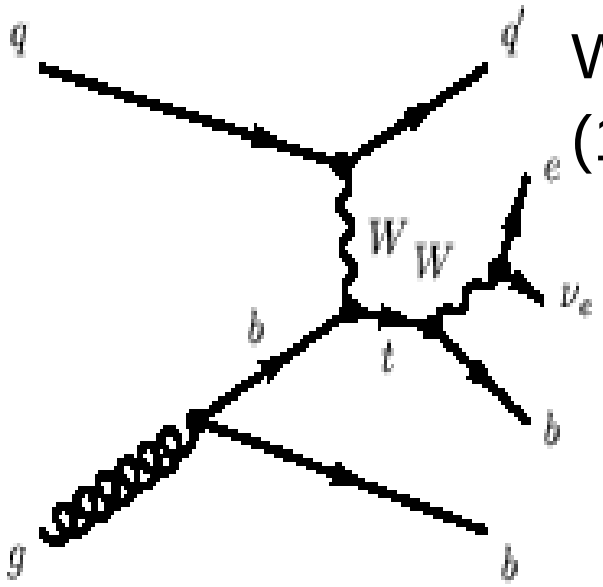
Plug Electron ID using Artificial Neural Network Techniques



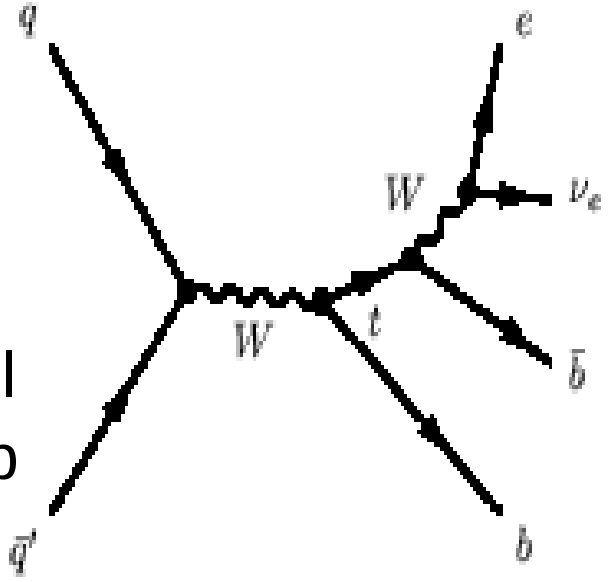
Yves Kemp, Thomas Müller,
Hartmut Stadie, Wolfgang Wagner
University of Karlsruhe

Paris, RTN meeting September 2004

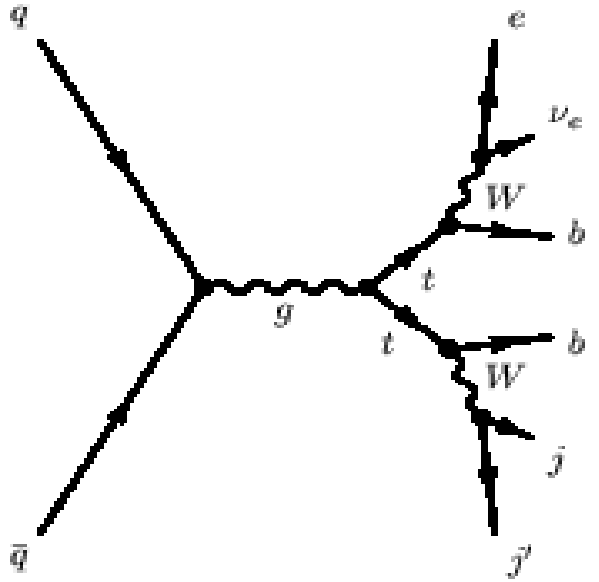
Signal and background processes



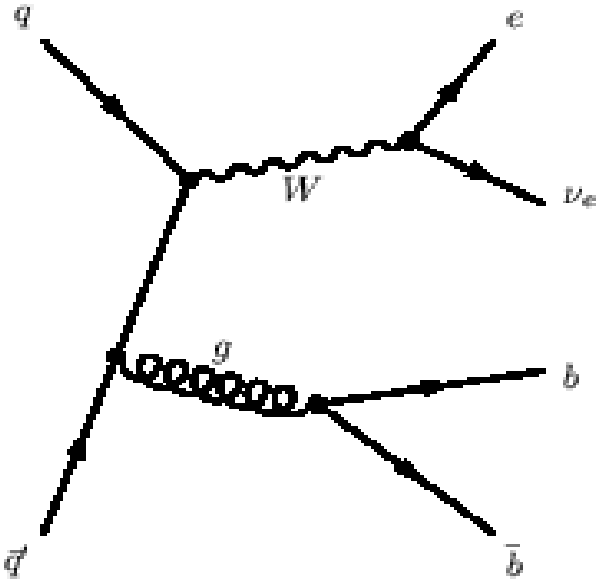
W-gluon-fusion
(1.98+-0.08)pb



s-channel
(0.88+-0.05)pb



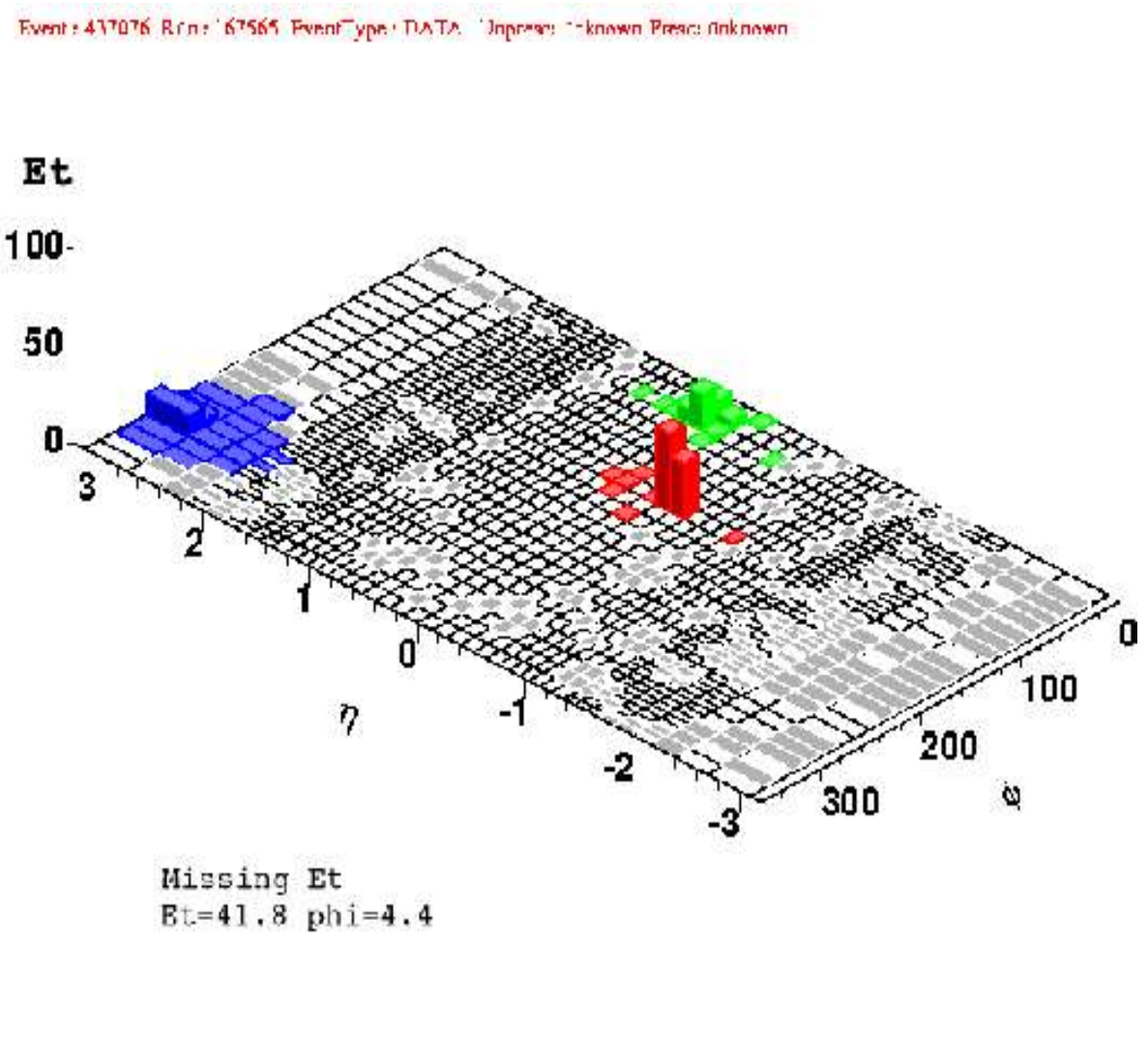
t-tbar
(6.7+-0.8)pb



W-b-bbar

Signature

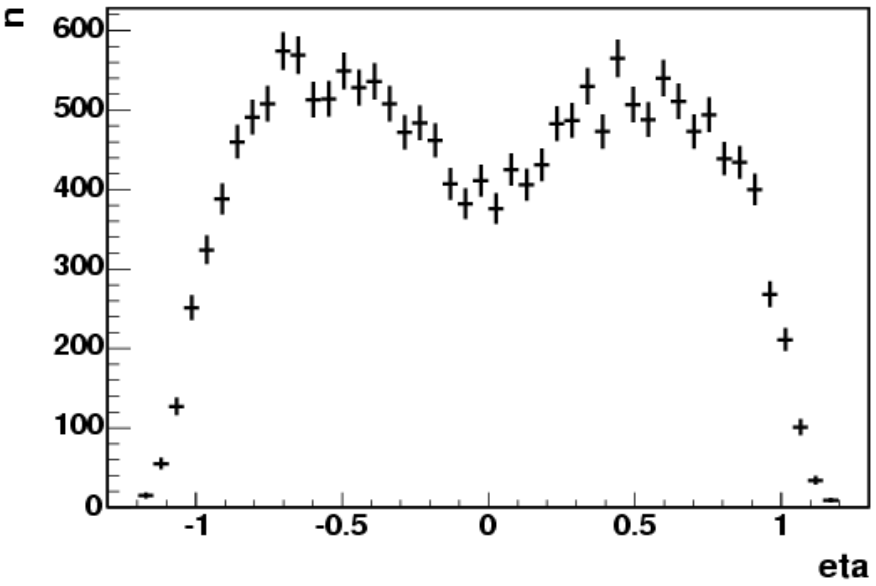
- W +2 jets ➔ b-tag
- W ➔ e/μ + neutrino
  - Electron-ID
- Run I: Only central electrons
- Run II: Also electrons in forward calorimeter



Electron ID in for single top now

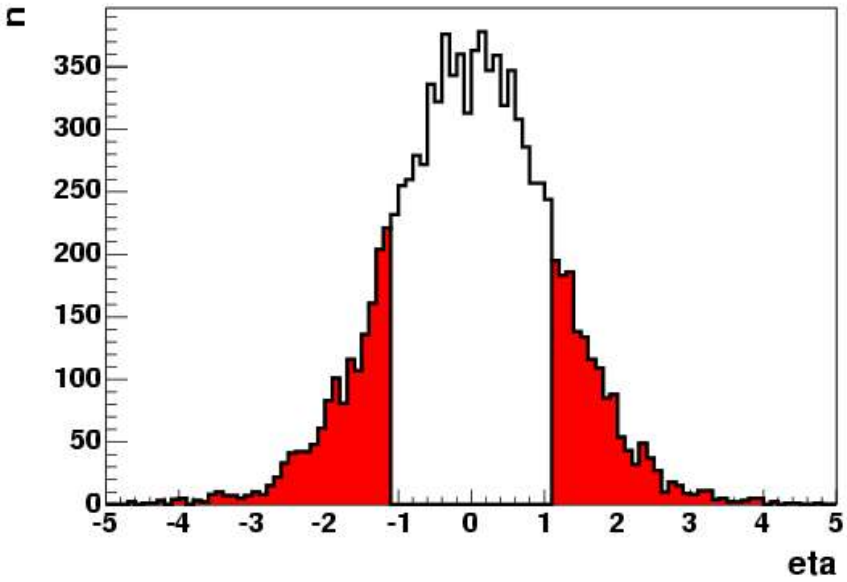
Limit for single top quark production: t-channel < 10.1 @ 95% C.L

Now: Only central electrons



(electrons after single top preselection)

t-channel MC



Ca 30% with |eta|>1.1

Variables for plug electron ID

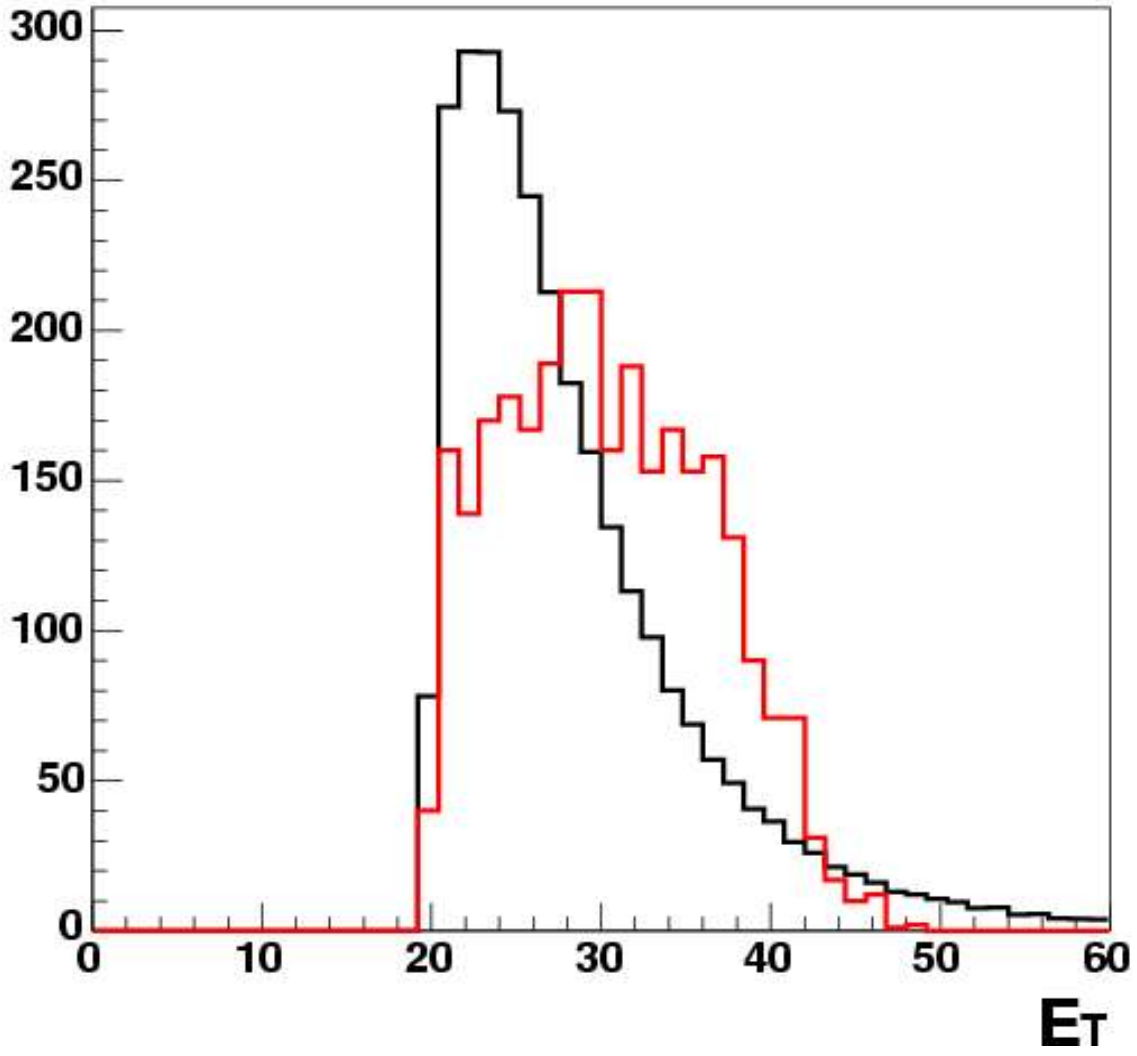
- Fiducial cut: 1.2 < |eta| < 2.8
- EmE_T
- HadE/EmE (sliding cut)
- Isolation Ratio
- PEM χ^2 (comparison with test beam data)
- PES 5by9 u/v (Shower profile in PES in u and v direction)

Selection of the samples

- Signal sample:
  - 1 tight central electron
  - Another electron candidate in plug (Z-Candidate)
  - Cut to be independent of trigger cuts
  - ~3000 events remain
- Background sample:
  - 2 balanced jets (1 central, 1 plug)
  - Several preselection cuts
  - ~70000 events remain

Both samples taken from data! (bpel08)

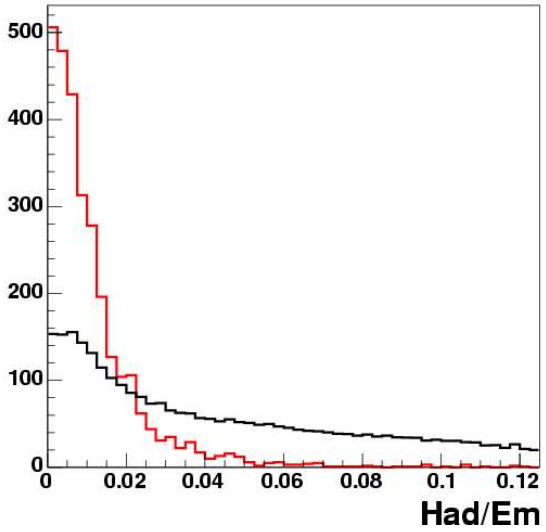
Control plot: E_T of plug electron

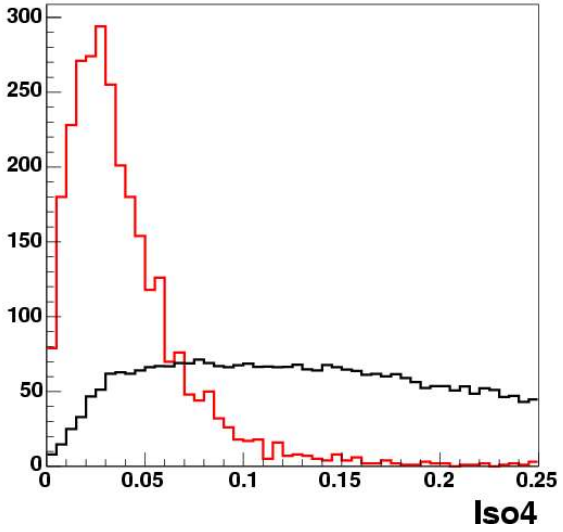


----Signal

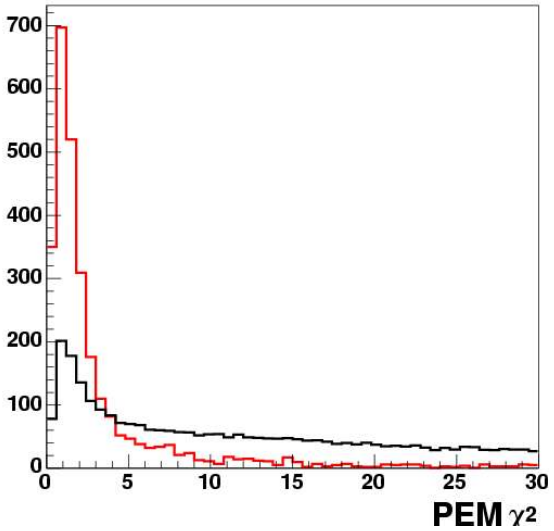
----Background

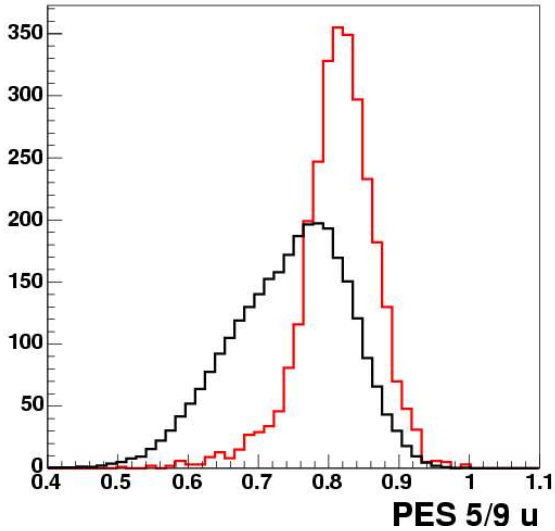
Selection variables

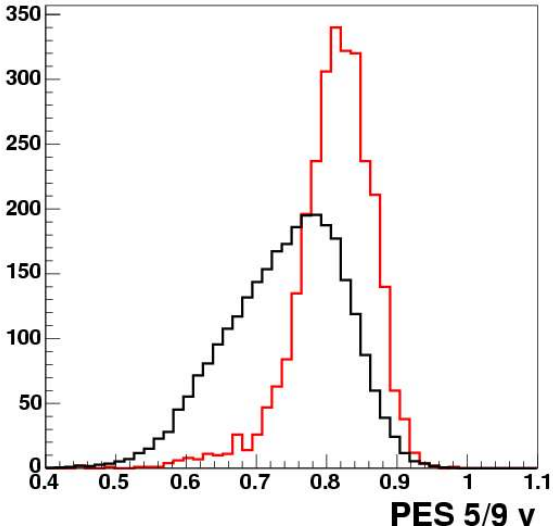




----Signal ----Background



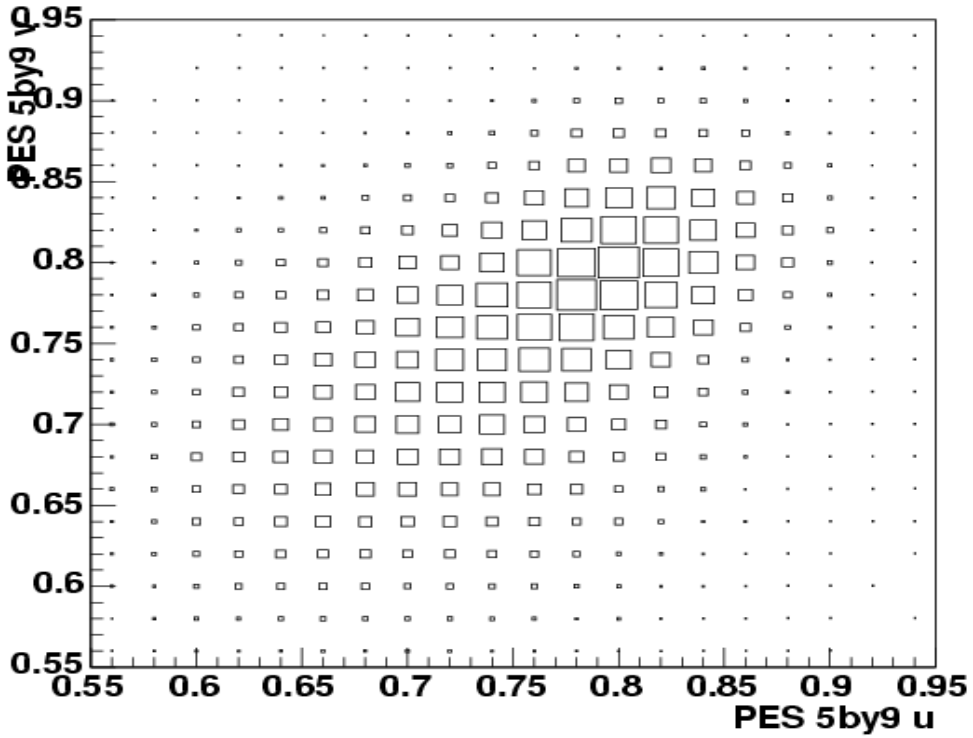




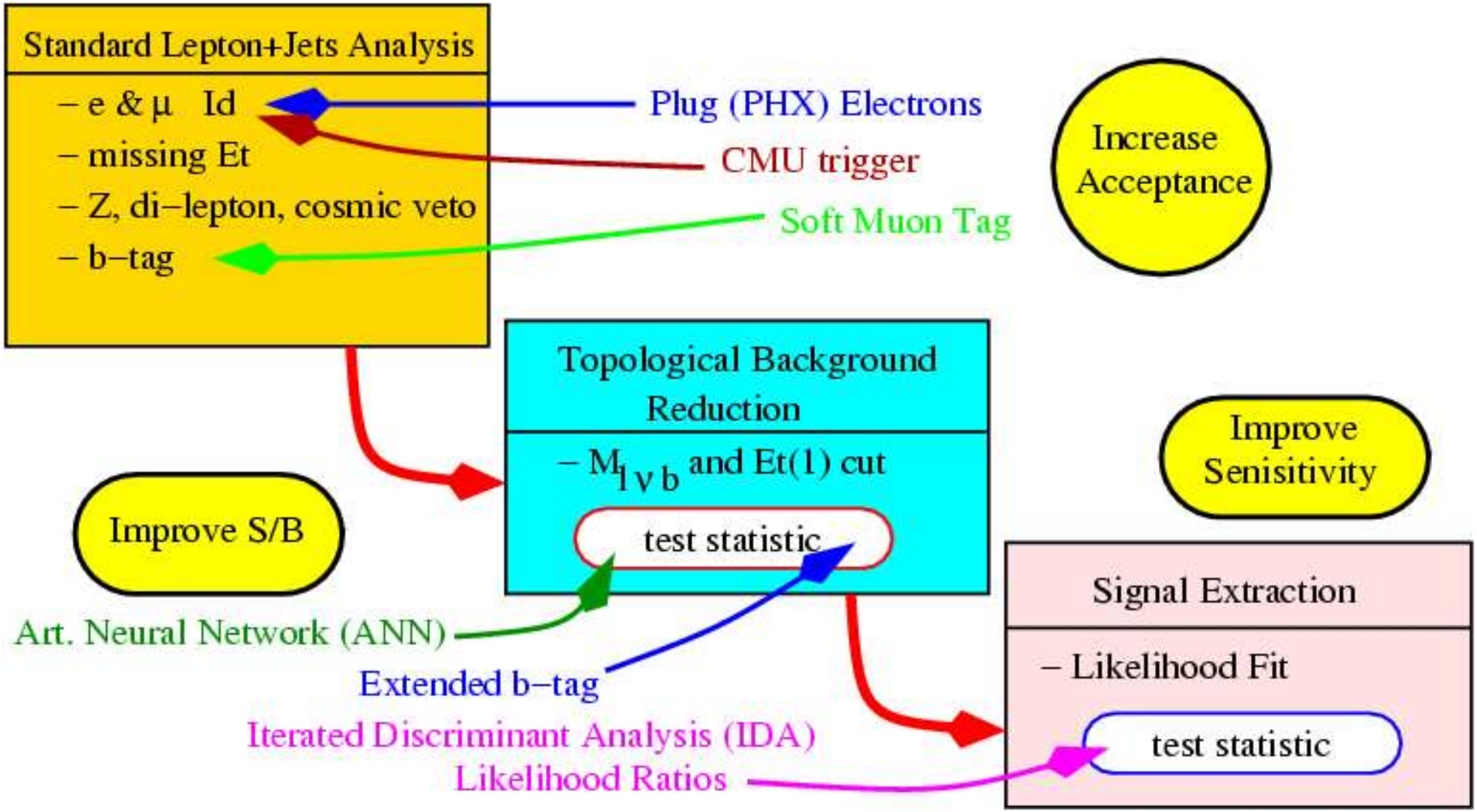
Correlation matrix

	Target	HadEm	Iso	PEM chi2	PES 5/9 u	PES 5/9 v
Target	100.0%	-49.4%	-66.6%	-64.5%	42.9%	43.2%
HadEm	-49.4%	100.0%	**52.8%**	44.8%	-24.8%	-24.2%
Iso	-66.6%	**52.8%**	100.0%	**71.0%**	-38.9%	-38.5%
PEM chi2	-64.5%	44.8%	**71.0%**	100.0%	-42.8%	-43.3%
PES 5/9 u	42.9%	-24.8%	-38.9%	-42.8%	100.0%	**45.9%**
PES 5/9 v	43.2%	-24.2%	-38.5%	-43.3%	**45.9%**	100.0%

Target is -1 for background, 1 for signal

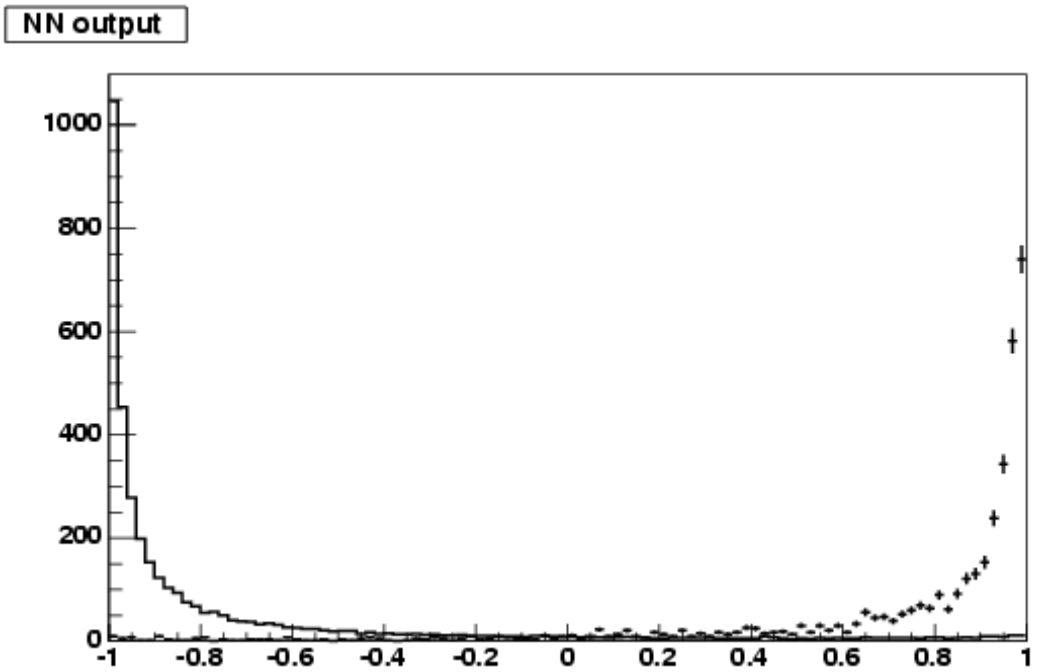


Correlation between the two PES variables due to cross talk and geometry


Standard Lepton+Jets Analysis
– e & μ Id
– missing Et
– Z, di–lepton, cosmic veto
– b–tag
Plug (PHX) Electrons
CMU trigger
Soft Muon Tag
Increase Acceptance
Topological Background Reduction
– $M_{l\nu b}$ and Et(1) cut
test statistic
Improve Senisitivity
Improve S/B
Art. Neural Network (ANN)
Extended b–tag
Iterated Discriminant Analysis (IDA)
Likelihood Ratios
Signal Extraction
– Likelihood Fit
test statistic

Artificial Neural Network

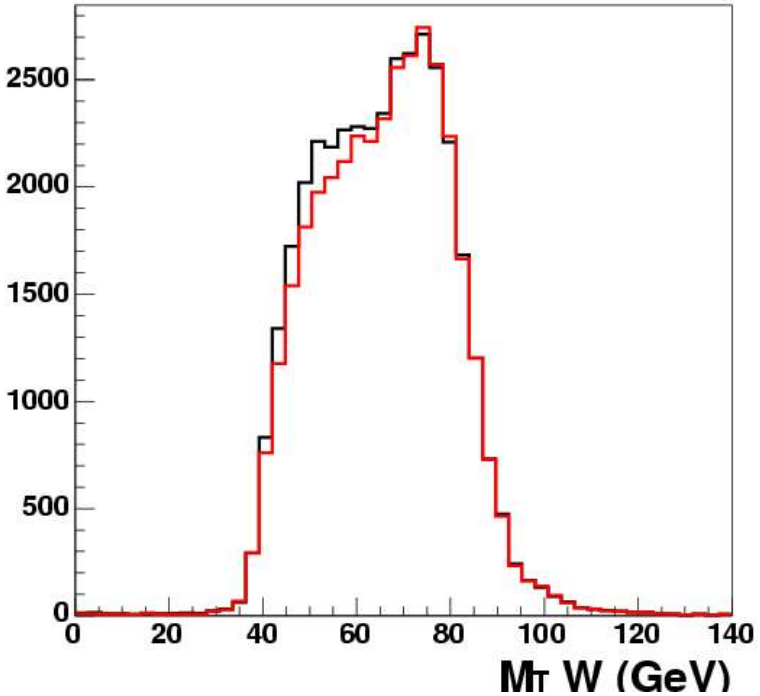
- 5 variables
  - Had/Em
  - Isolation
  - PEM chi2
  - PES 5/9 u/v
- 10 nodes in intermediate layer
- Binary classification (-1 background, 1 signal)
- 200 iterations



NN cut	Signal	Backgound
0.23	84%	4.6%
0.16	91%	5.3%

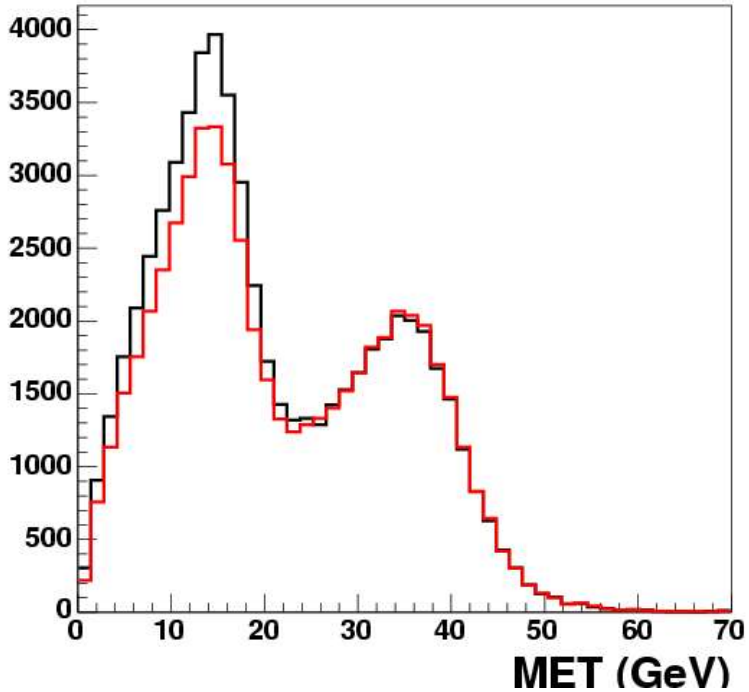
Cutbased:	84%	5.3%

Independent tests



--CDF tight

--NN cut



Transverse W-Mass
(MET>15 GEV)
NN cut: 36355 events
CDF tight: 37687 events

Missing ET
NN cut: 40291 ev. < 25 GeV
CDF tight: 34949 ev. < 25 GeV

Conclusion, outlook

- Correlations between selection variables
- ANN can improve selection and ID
- Good performance also on independent tests

- Can be used for electroweak physics
- Will be used in the next round of single top analysis