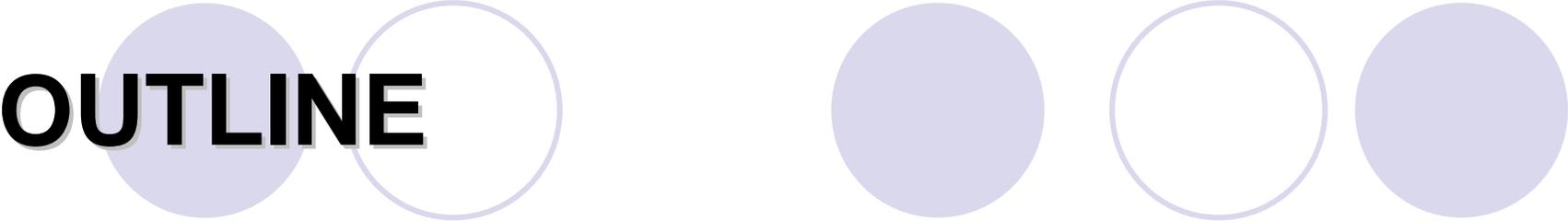


# H-matrix base on e-ID



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*March 31, 2006*  
*DOSAR*

# OUTLINE



- Motivation
- Principle of H-matrix – Hm5e & HM10e
- Data
- Performance of HM10e & HM5e
  - $\chi^2$  , e efficiency & jet rejection
  - HM10e & HM5e comparison
- Comparison of HM10e & LH
- Comparison of HM10e variables reconstructed by 11.0.1 & 11.0.41
- At UTA...
- Summary

# Motivation

- Vector Boson Fusion is second dominant Higgs production
- Electron identification from  $H \rightarrow ZZ^* \rightarrow 4e$  &  $H \rightarrow WW^* \rightarrow 2e2\nu$   
→ clean signal
- D0 constructs H-Matrices in many dimensions and computes their  $\chi^2$  for e-ID  
→ has been proved a great alternate tool for electron and hadron separation
- Improve electron ID by generating a quantity utilizing H-matrix for ATLAS electron  
→ identify good electron ID.
- Measure and understand Electron ID efficiencies and jet of hadron rejection

# Principle of H-matrix

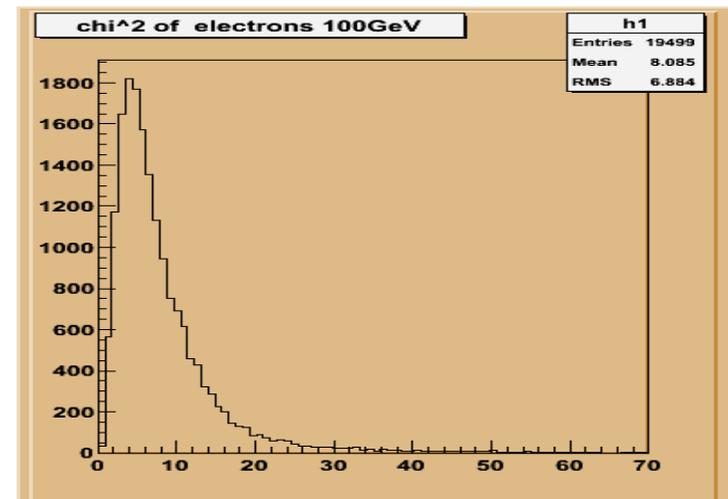
- H-matrix uses the correlation in **transverse** and **longitudinal shower shape** of electrons. Using these variables, a covariant matrix  $M$  is built

$$M_{ij} = \frac{1}{N} \sum_{n=1}^N (y_i^{(n)} - \bar{y}_i) (y_j^{(n)} - \bar{y}_j)$$

- $\chi_m^2$  for a given candidate object is defined as a measure of how much electron like the object is

$$\chi_m^2 = \sum_{l,j=1}^{dim} (y_l^{(m)} - \bar{y}_l) H_{lj} (y_j^{(m)} - \bar{y}_j)$$

where,  $\mathbf{H} \equiv \mathbf{M}^{-1}$



# HM5e & HM10e

- $\eta$  coverage is  $< 2.47$
- Crack region is not considered.
- List of HM10e & HM5e variables

	HM5e	HM10e		HM5e	HM10e
e0/etot		✓	e233/e277	✓	✓
e1/etot	✓	✓	weta1		✓
e2/etot	✓	✓	weta2	✓	✓
e3/etot	✓	✓	frac1		✓
e4/etot		✓	isol		✓

- Built covariant matrix M.
- Parameterize eta or energy dependence of H-matrix variables or elements of matrix M.
- Using these relation, calculate elements of H-matrix and  $\chi^2$  for each electron candidate

# Data

- ZeeJimmy(mc11.004201.ZeeJimmy)
- DiJet(mc11.005802.JF17\_pythia\_jet\_filter)

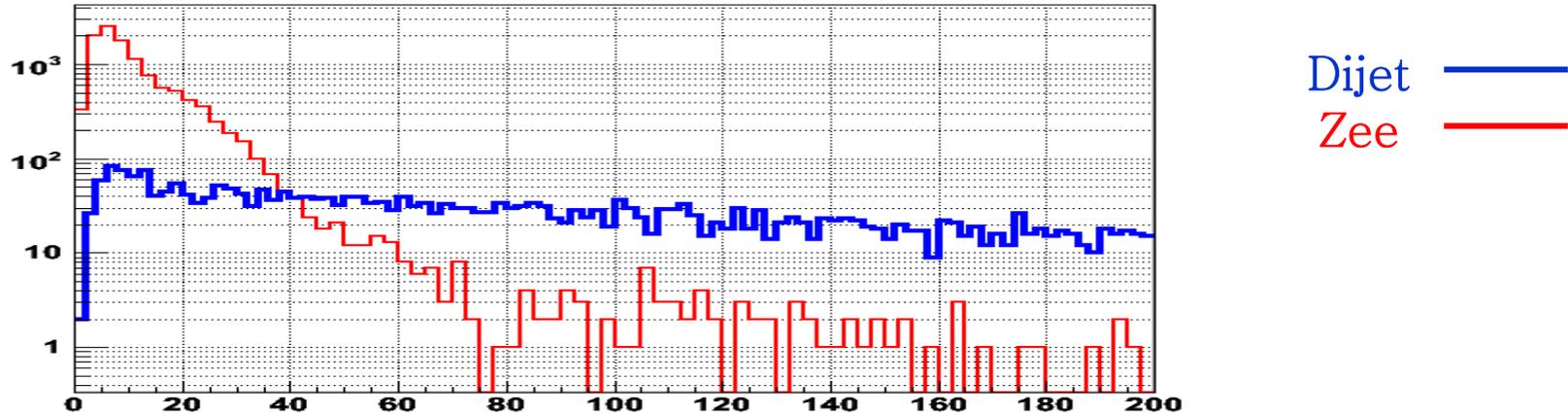
		2e/evnt	dr(<0.05)	et(>20Gev)	IsEM	track
<b>Zee</b>	<b>20671</b>	<b>16846</b>	<b>16834</b>	<b>13154(11711)</b>	<b>9077</b>	<b>11063</b>
<b>Dijet</b>	<b>152187</b>	-	-	<b>7755(6475)</b>	<b>261</b>	<b>3393</b>

(); excluding bad HM10e variables.

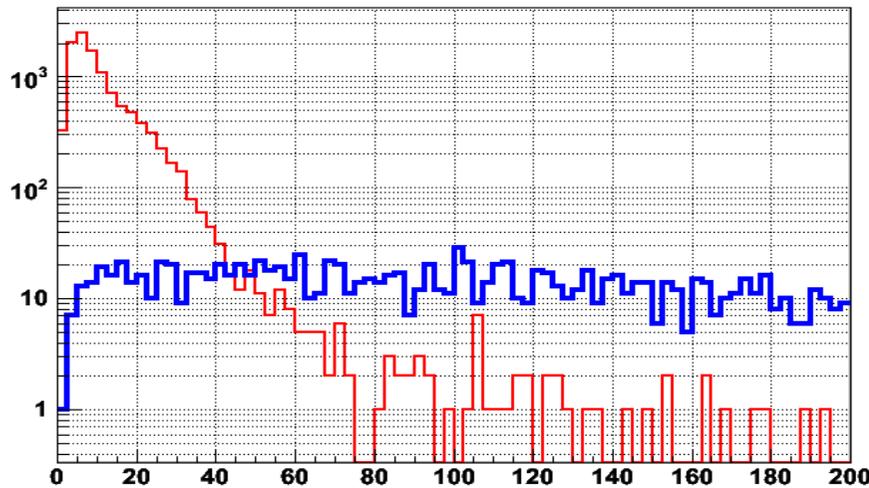
- 100GeV Electron
  - dc2.003061.digit.E7\_eminus\_e100\_eta25(11.0.1)
  - mc11.004003.Electron\_e100 (11.0.41)

# HM10e $\chi^2$ for Zee and DiJet

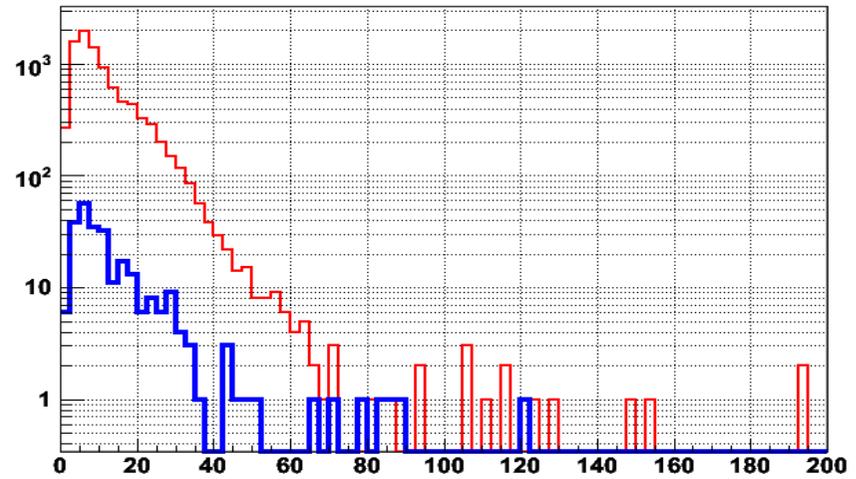
chi<sup>2</sup> Histogram for el in Zee and DiJet



chi<sup>2</sup> Histogram for el in Zee and DiJet w/ trackmatch

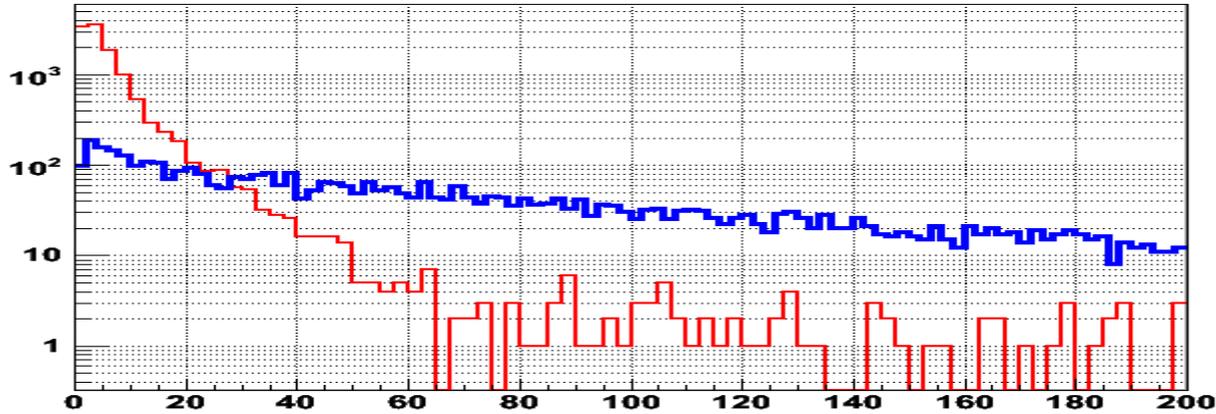


chi<sup>2</sup> Histogram for el in Zee and DiJet w/ IsEM



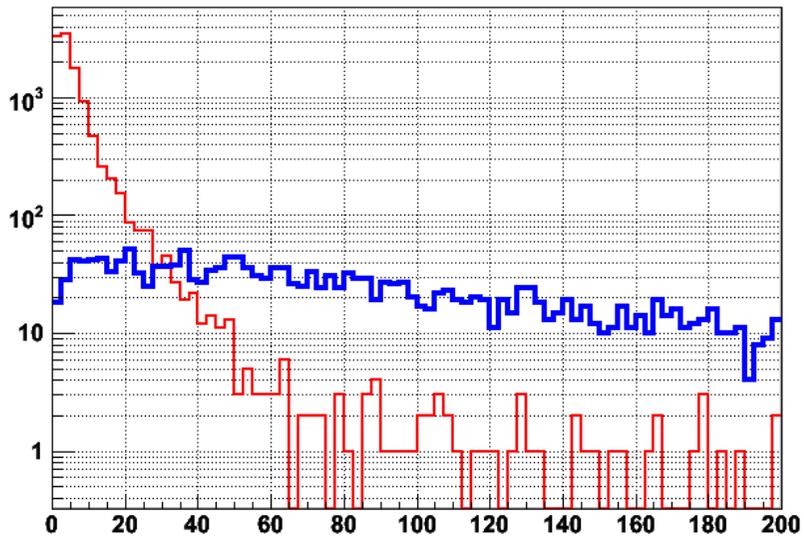
# HM5e $\chi^2$ for Zee and DiJet

chi<sup>2</sup> Histogram for el in Zee and DiJet

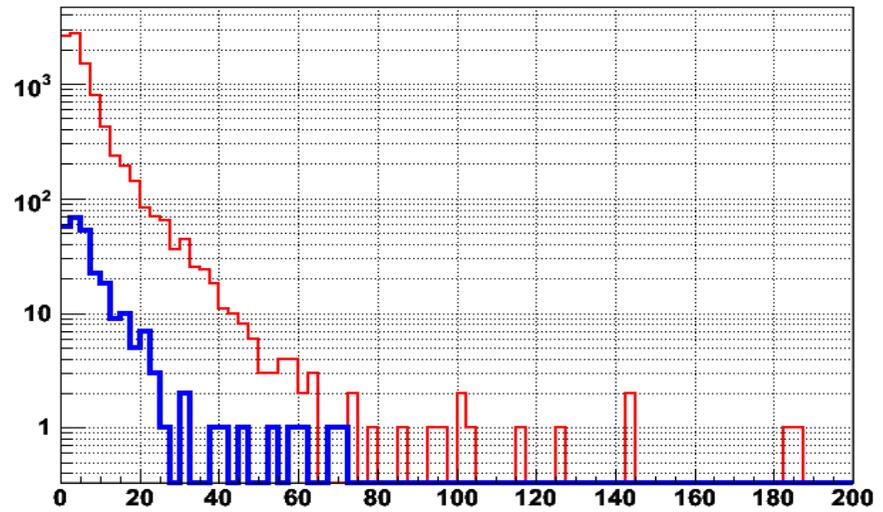


DiJet ———  
Zee ———

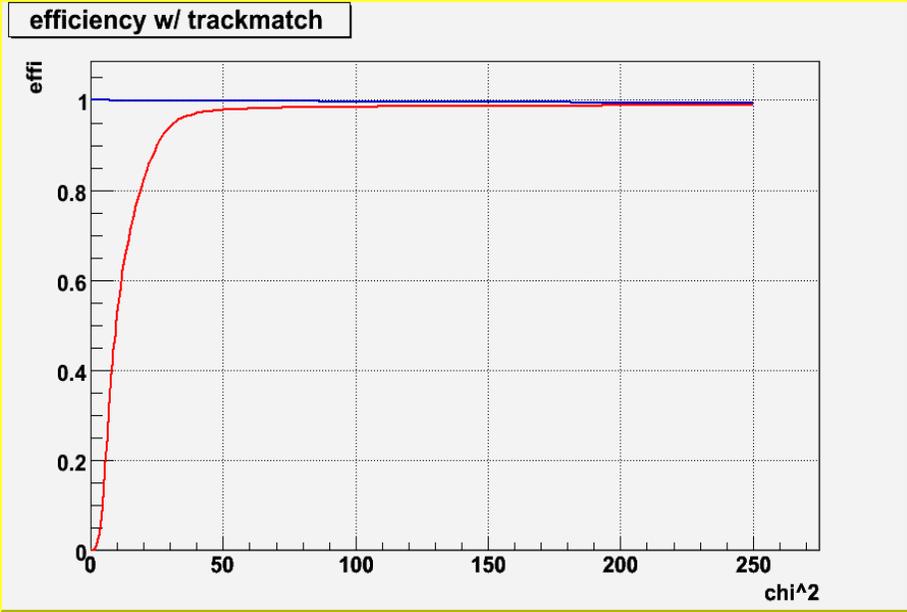
chi<sup>2</sup> Histogram for el in Zee and DiJet w/ trackmatch



chi<sup>2</sup> Histogram for el in Zee and DiJet w/ lsEM



# HM10e e efficiency and jet rejection

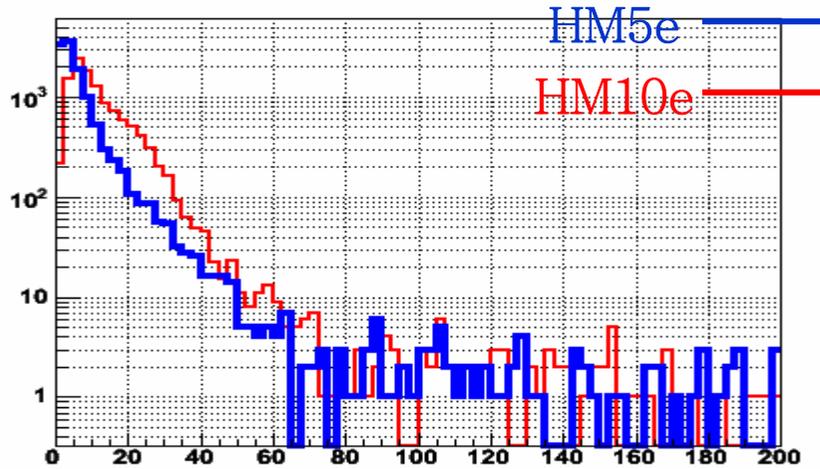


	Zee	DiJet
25	0.8890	0.9978
40	0.9635	0.9968
50	0.9725	0.9962

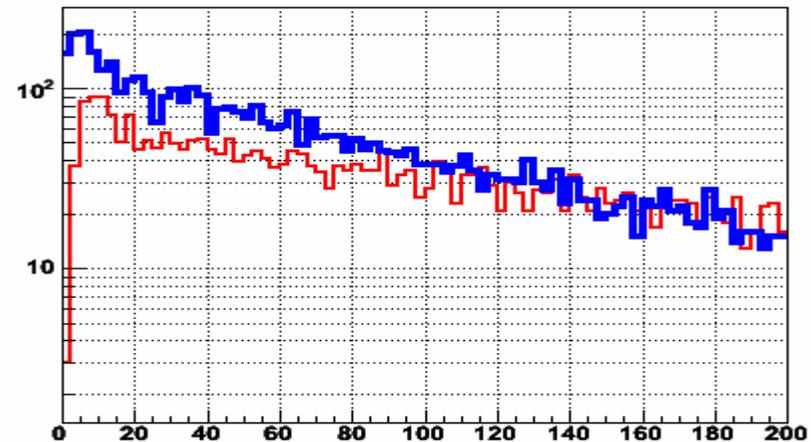
trmatch	Zee	DiJet
25	0.9008	0.9995
40	0.9716	0.9992
50	0.9788	0.9990

# HM10e & HM5e comparison

chi<sup>2</sup> of HM5e & HM10e el in Zee



chi<sup>2</sup> of HM5e & HM10e for DiJet

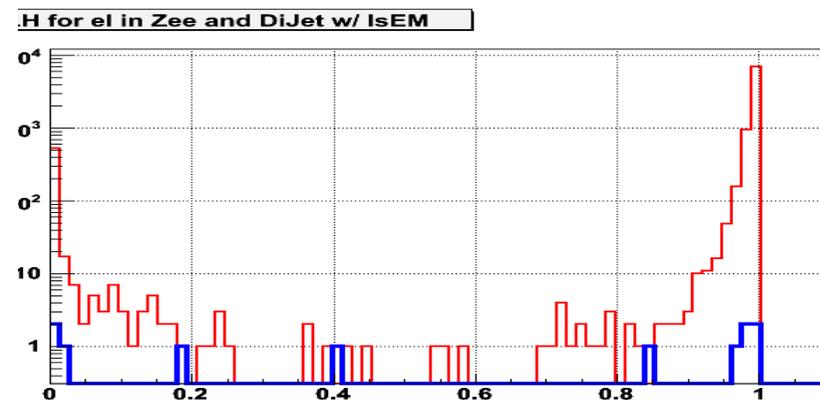
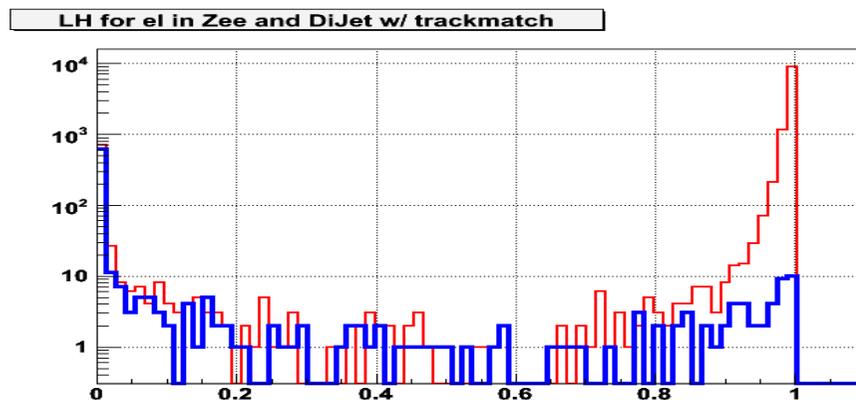


	Zee		DiJet	
w/o	0.9636	0.9635	0.9945	0.9968
trmatch	0.9488	0.9488	0.9989	0.9994
IsEM	0.9520	0.9524	0.9991	0.9991

# HM10e & LH comparison

	HM10e		LH	
trmatch	0.9556	0.9996	0.9563	0.9959
IsEM	0.9874	0.99996	0.9887	0.99994

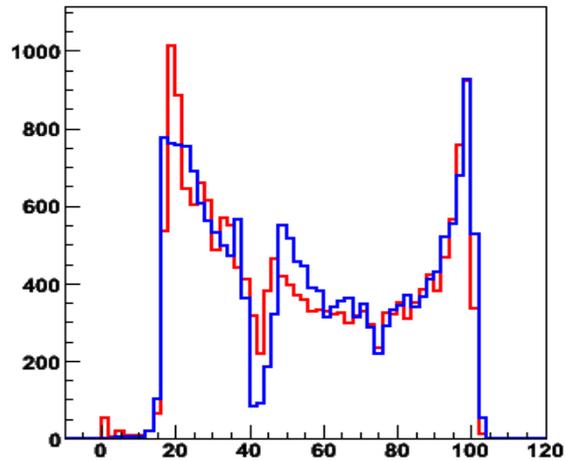
- ◆ IsEM is not independent with track match anymore
- ◆ LH has bad value(-999.) when track requirement is not satisfied



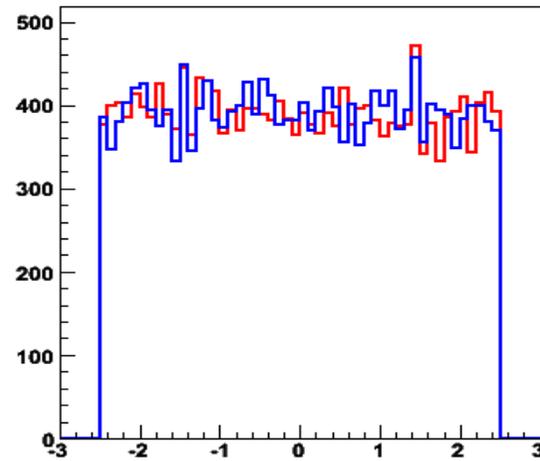
# Variables of HM10e( on 11.0.1 & 11.0.41)

11.0.41 — blue line  
11.0.1 — red line

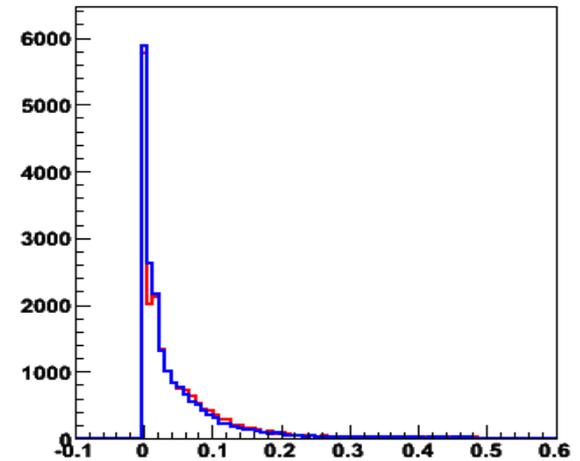
et for CSC & DC2



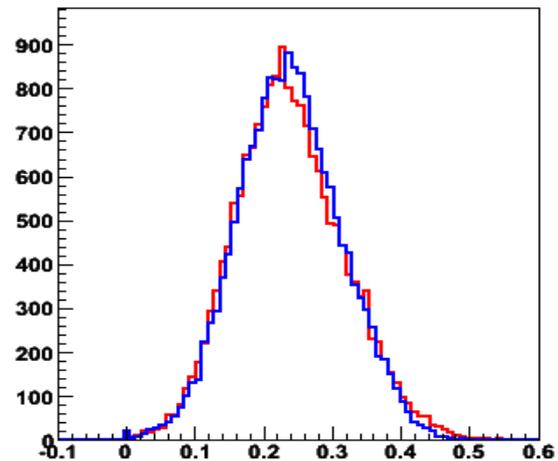
eta for CSC & DC2



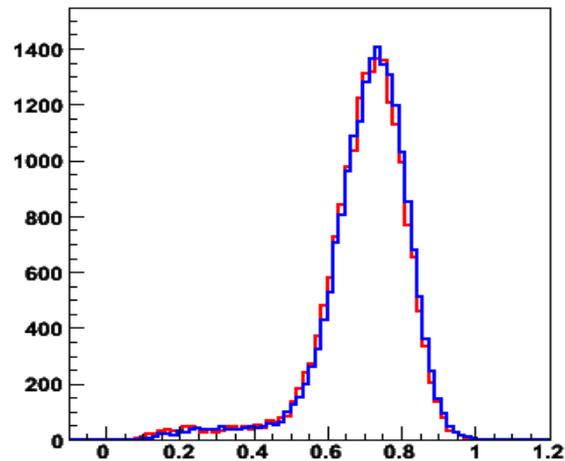
fre0 for CSC & DC2



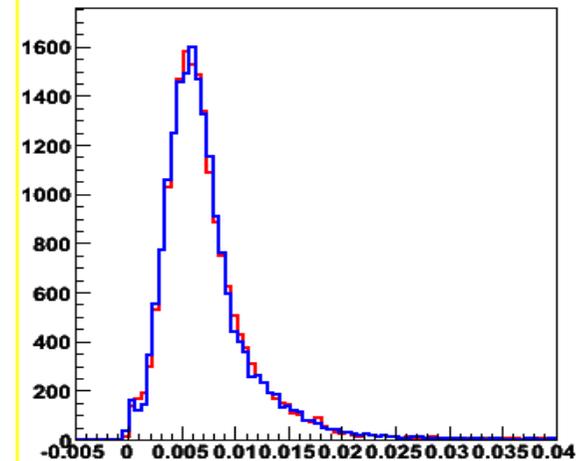
f1 for CSC & DC2



fre2 for CSC & DC2



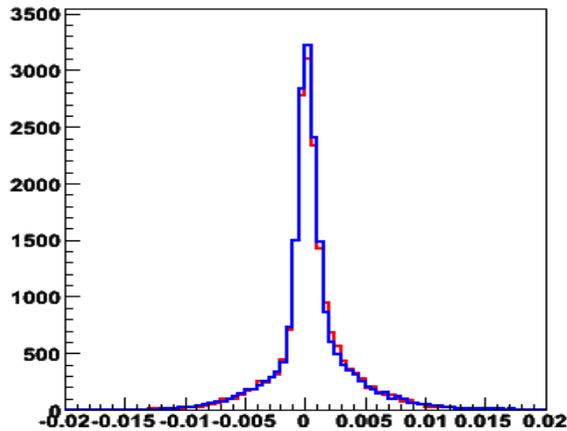
f3 for CSC & DC2



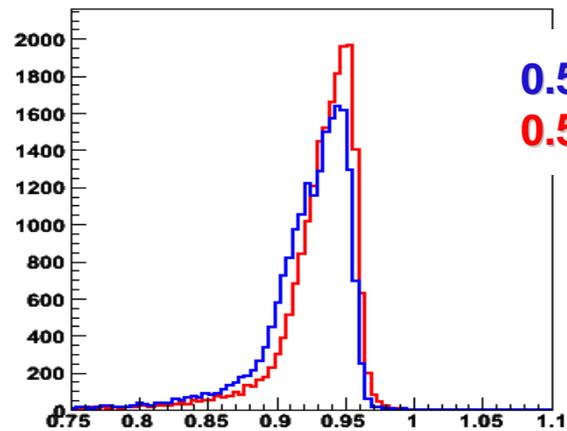
# Variables of HM10e( on 11.0.1 & 11.0.41)

11.0.41 —  
11.0.1 —

fh1 for CSC & DC2

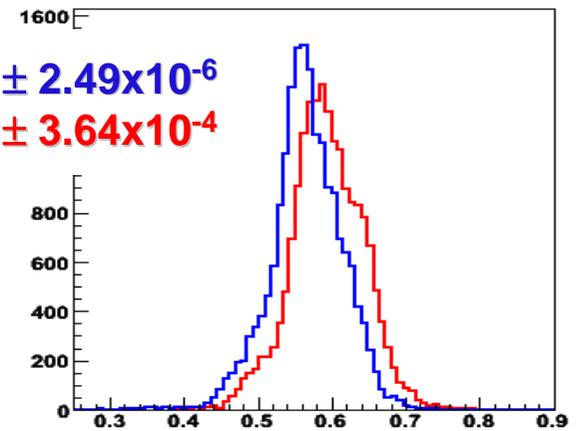


fr37 for CSC & DC2

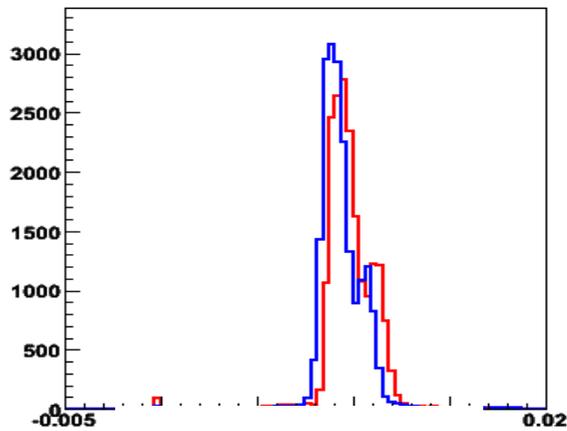


$0.567 \pm 2.49 \times 10^{-6}$   
 $0.593 \pm 3.64 \times 10^{-4}$

weta1 for CSC & DC2



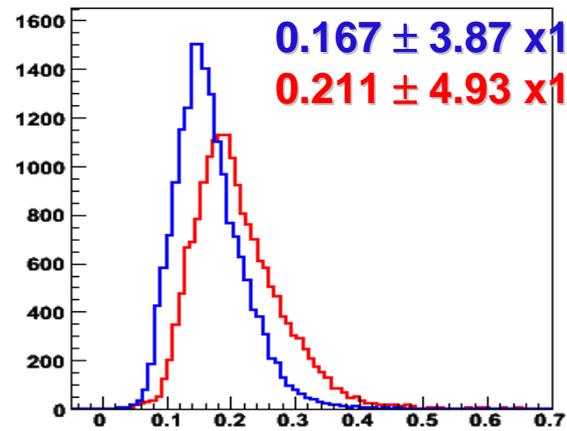
weta2 for CSC & DC2



$0.0094 \pm 9.04 \times 10^{-6}$   
 $0.0099 \pm 1.02 \times 10^{-5}$

H-n - ID

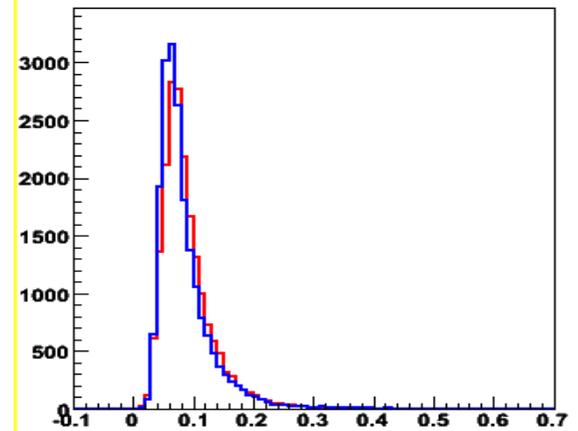
fracs1 for CSC & DC2



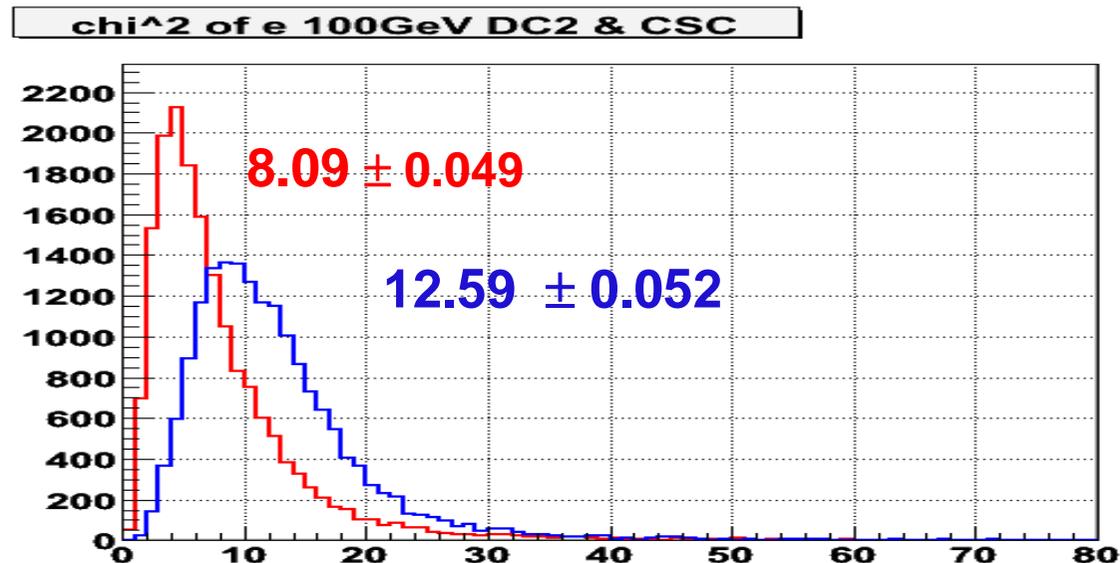
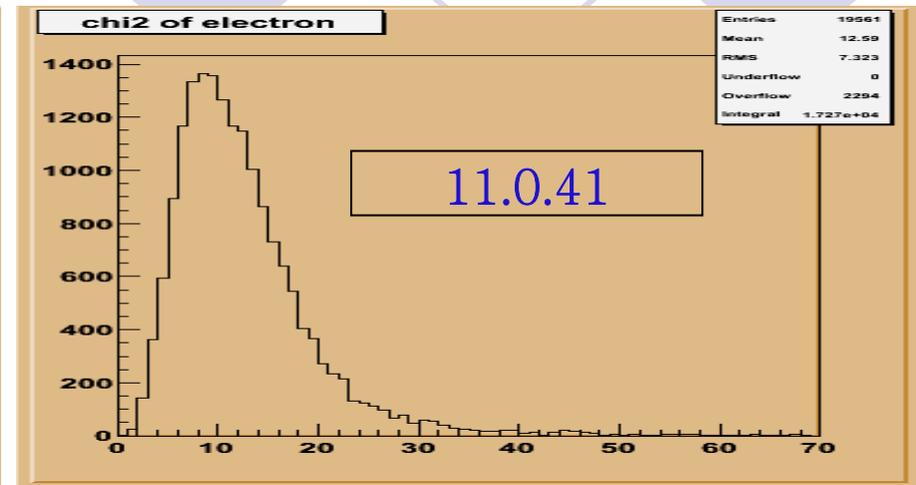
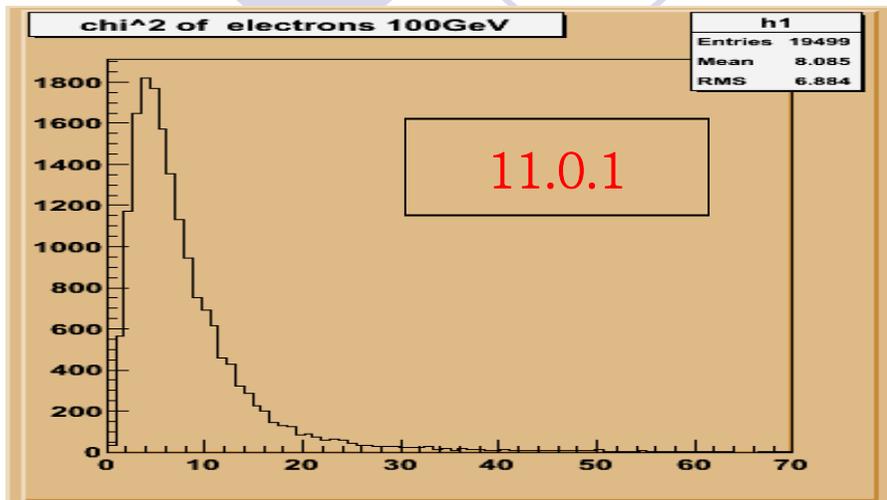
$0.167 \pm 3.87 \times 10^{-4}$   
 $0.211 \pm 4.93 \times 10^{-4}$

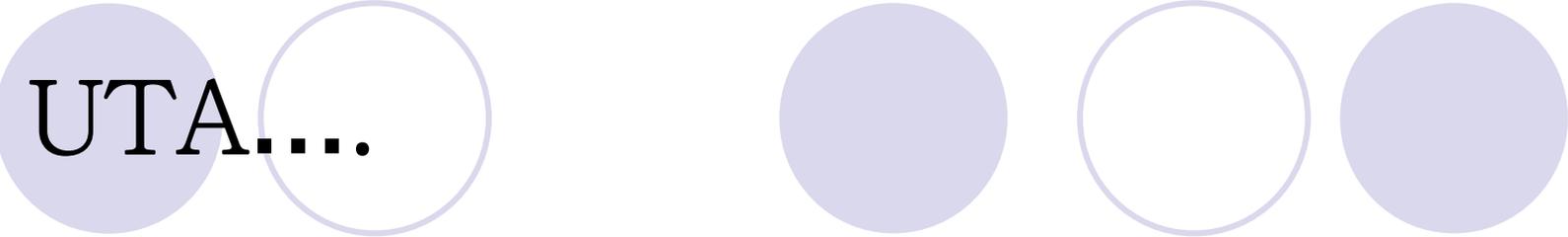
DOAR at UTA 03/31/2006

isol for CSC & DC2



# HM10e $\chi^2$ for e (100GeV)





At UTA....

- Using CERN & BNL ATLAS analysis servers via remote login (SSH)
  - Plan to perform this development work utilizing UTA resources
  - Reduce the time required to produce ESD and generate H-matrix
- Seeking for suitable variables of higher dimensional H-matrix that gives best discriminating power between e and hadrons
- Understanding algorithms in the each ATLAS analysis package.

# SUMMARY

- H-matrix is a strong method for e-ID and jet rejection.
- HM10e & HM5e have been tested on Zee and DiJet
- HM10e has been compared to HM5e
  - HM10e has higher jet rejection over HM5e
- HM10e efficiency is comparable to LH.
- HM10e variables reconstructed by 11.0.1 and 11.0.41 are mostly consistent with each other (except fr37, weta1, weta2, fracs1 and isol)
  - need to regenerate H-matrix on 11.0.41

## To DO...

- Regenerations of HM10e and HM5e processing using by CSC, 11.0.41
- prepare to release HM10e & HM5e
- move on H-matrix for gamma