$t\bar{t} \rightarrow \tau$+jets update: 2-component fits to data

Giorgio Cortiana,
University of Padova and INFN

Outline:

- ***Brief analysis review***
- ***2-c fits: data top fraction***
- ***2-c fits: background composition***
- ***Conclusions, work status and plans***

Dataset and Trigger:

TOP_MULTI_JET: ***gset0d*** **up to Aug 2004: 311 pb^{-1}, goodrun v7.0 (1,1,4,1)**

MC :

- ***ttopel*** **(153 fb^{-1}), Pythia ttbar, M_t = 178 GeV**
- ***atop2t*** **(200 K), Alpgen+Herwig W($\tau\nu$)+bb+2P**
- ***ttop0b*** **(3 M), Alpgen+Herwig bb+4P**

Offline version: 5.3.3_nt5

Jet Corrs: jetCorr04b

CDF-7292, 7553

Background prediction:

Tag Rate Parametrization

3 (E_T^{L5} ≥15; |η|<2.0) jet evts

3-d (E_T, N_{TRK}, Met_{PRJ})

Positive Tagging Matrix

Kinematical selection

- **N jets(E_T^{L5} ≥15; |η|<2.0) ≥ 4**
- $\not{E}_T / \sqrt{\sum E_T} \geq 4.00$
- **min Δφ(met,jet) ≥ 0.4 rad**

CDF-7291, 7382, 7553

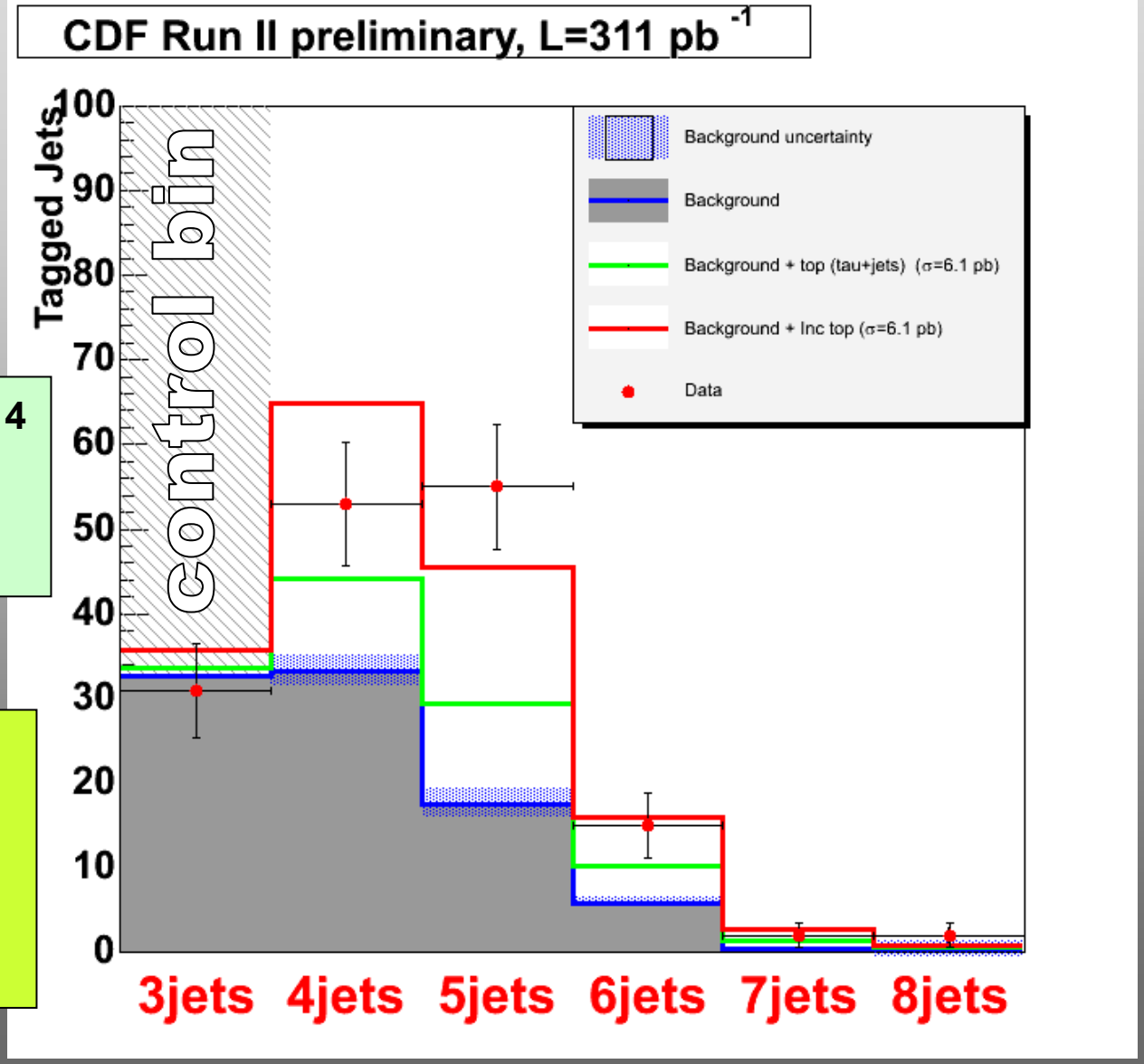
before tagging

N evt	$MC_{(\tau+jets)}$	$MC_{Incl.}$	MJ
Total	149,234	1,021,924	4,249,644
Prereq	74,786	556,575	3,897,755
NJet	72,597	547,309	2,781,788
MetSig	29,768	77,545	3,996
DPhiMetJet	19,035	49,421	597
in 311 pb^{-1}:	35.36	91.81	597
S/N $\tau + jets$: $N_{mc}^{\tau}/(N_{obs}^{data} - N_{mc}^{incl})$			0.07
S/N Inclusive: $N_{mc}^{incl}/(N_{obs}^{data} - N_{mc}^{incl})$			0.18

After ≥ 1 tag requirement...

- N jets(E_T^{L5} ≥15; |η|<2.0) ≥ 4
- $\not{E}_T / \sqrt{\sum E_T} \geq 4.00$
- min Δφ(met,jet) ≥ 0.4 rad

- matrix-based background prediction is corrected with an iterative procedure to account for the ttbar presence in the pre-tag sample.



2-component fits to data

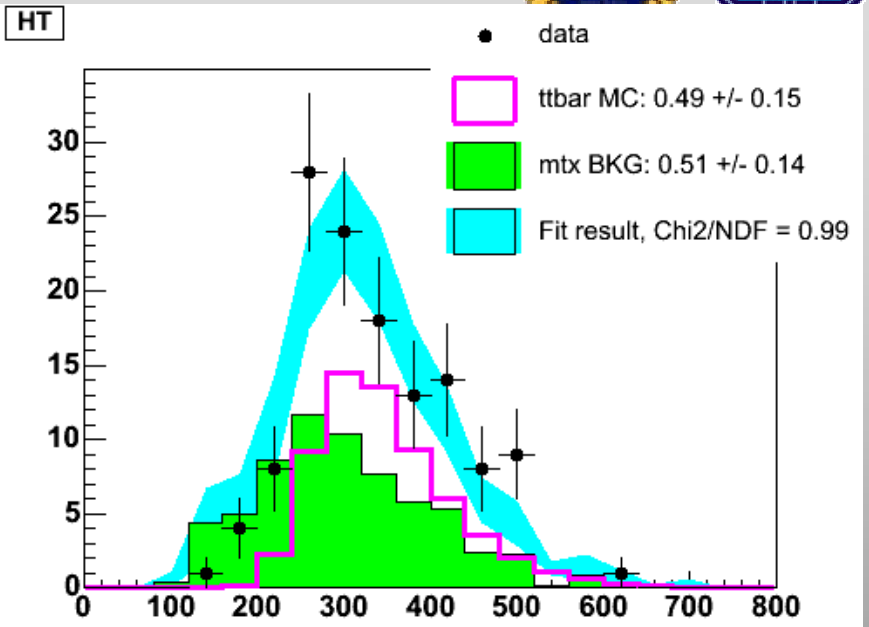
The positive tagging matrix can provide more than the absolute amount of tags in the sample after kin sel: it can be used to extract background shapes for kinematical variables.

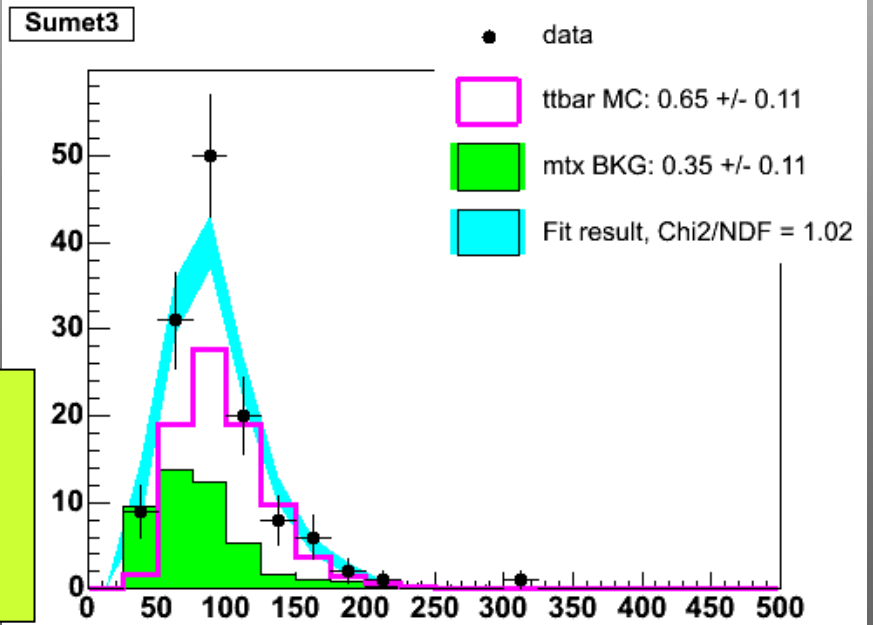
This can be used to fit data distribution after kin sel to the sum of two templates:

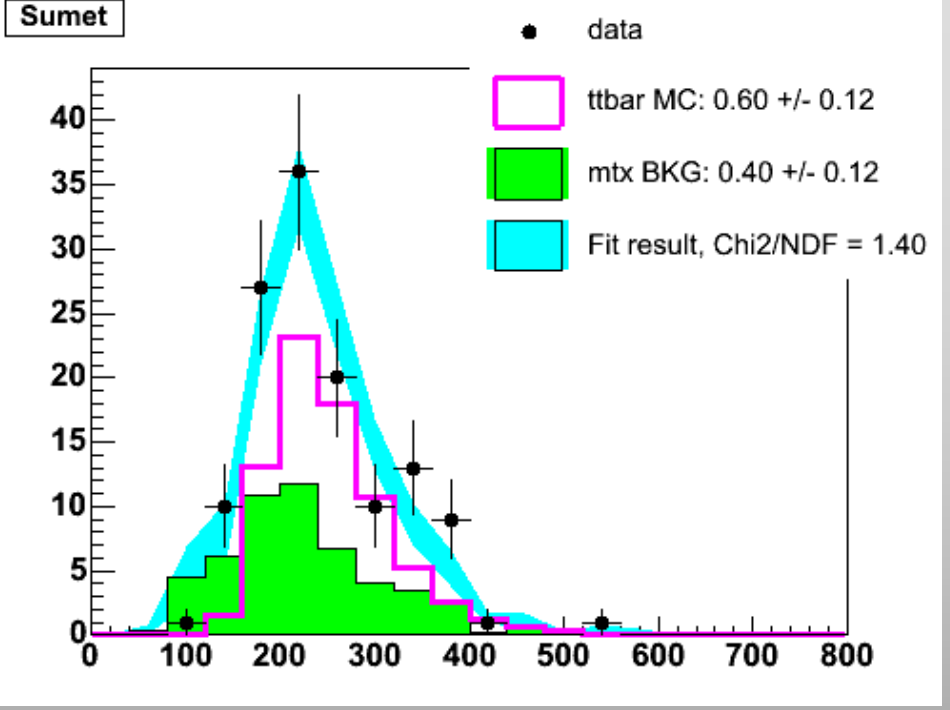
- Inclusive ttbar template
- Tagging Matrix extracted template

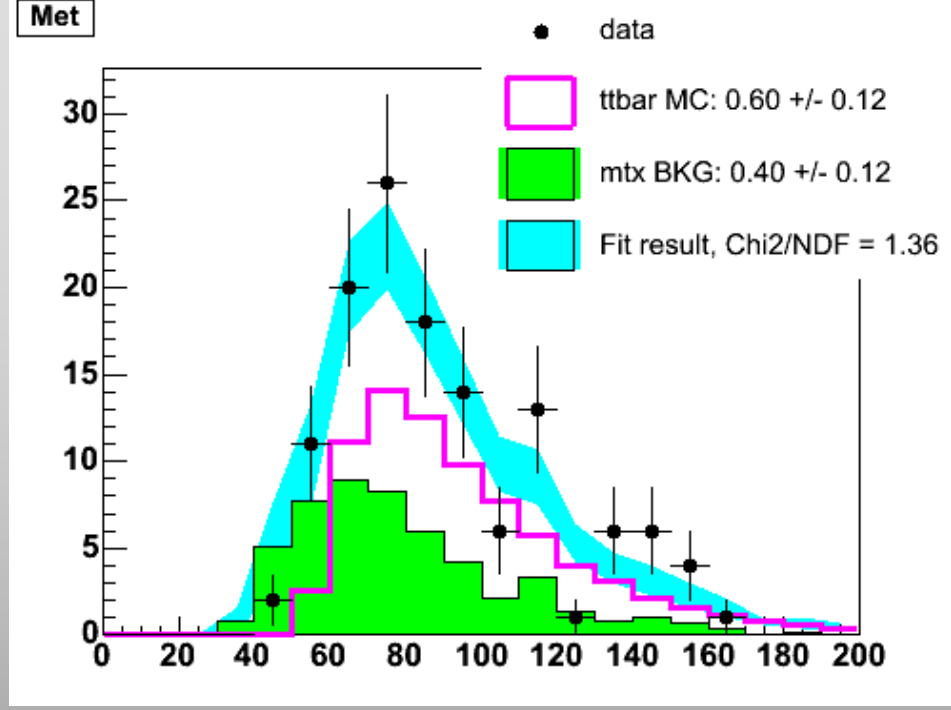
And then to extract the relative fractions of signal and background in the data we are selecting.

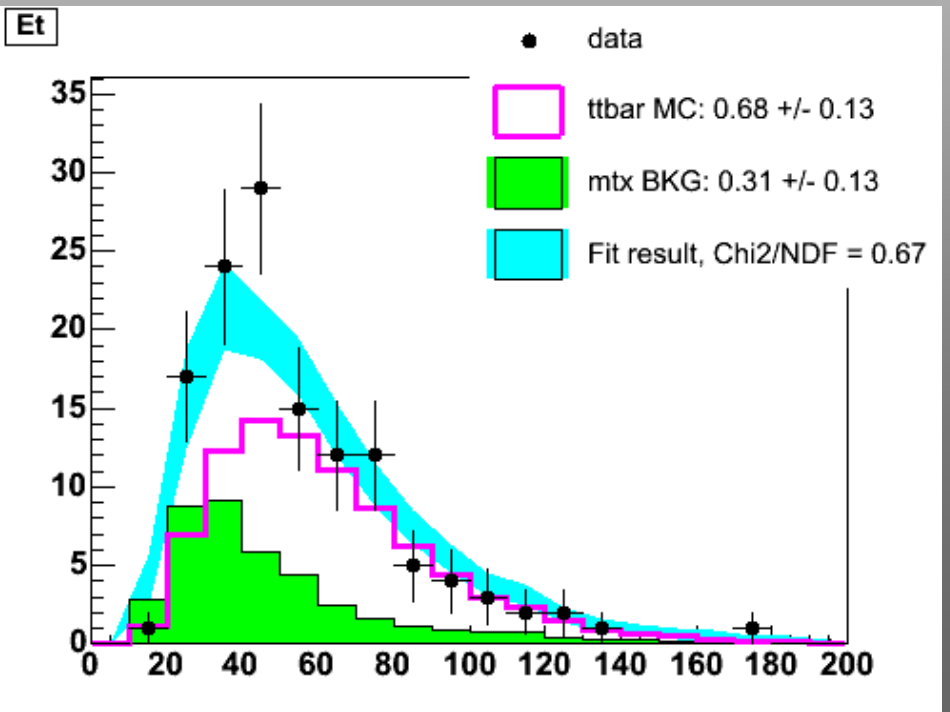
The fits minimize a χ^2 that accounts for data and templates statistical uncertainties.
In the data distribution there is an entry per each positive tag.

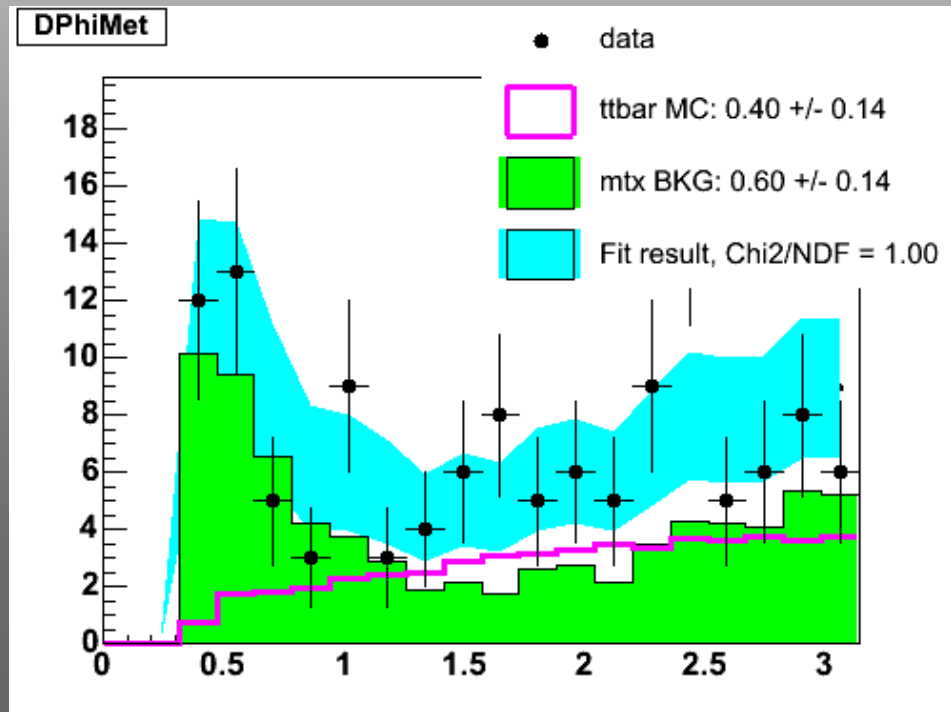





Sumet
data
ttbar MC: 0.60 +/- 0.12
mtx BKG: 0.40 +/- 0.12
Fit result, Chi2/NDF = 1.40
0 5 10 15 20 25 30 35 40
0 100 200 300 400 500 600 700 800


Met
data
ttbar MC: 0.60 +/- 0.12
mtx BKG: 0.40 +/- 0.12
Fit result, Chi2/NDF = 1.36
0 5 10 15 20 25 30
0 20 40 60 80 100 120 140 160 180 200


Et
data
ttbar MC: 0.68 +/- 0.13
mtx BKG: 0.31 +/- 0.13
Fit result, Chi2/NDF = 0.67
0 5 10 15 20 25 30 35
0 20 40 60 80 100 120 140 160 180 200

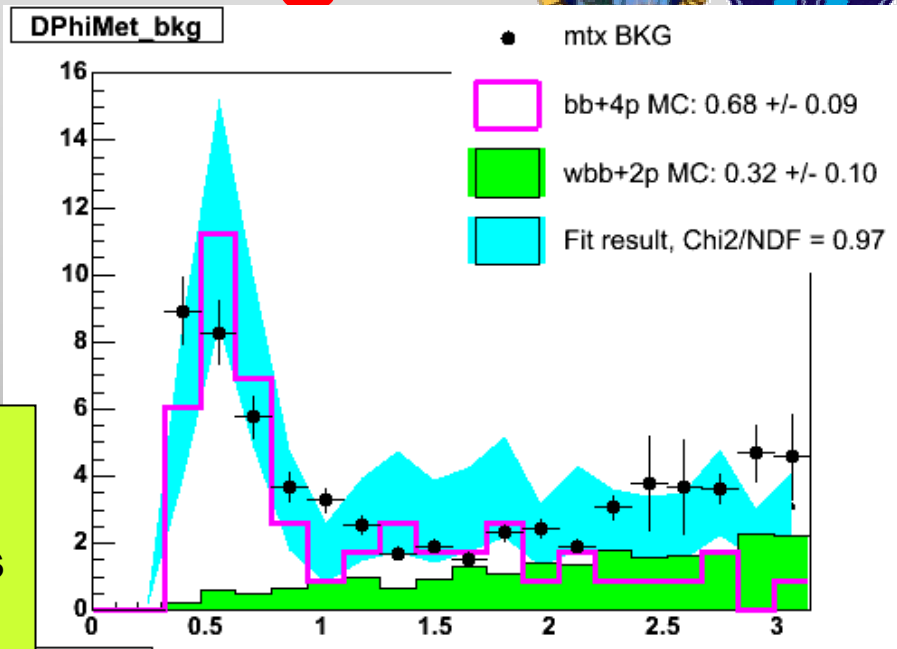

DPhiMet
data
ttbar MC: 0.40 +/- 0.14
mtx BKG: 0.60 +/- 0.14
Fit result, Chi2/NDF = 1.00
0 2 4 6 8 10 12 14 16 18
0 0.5 1 1.5 2 2.5 3

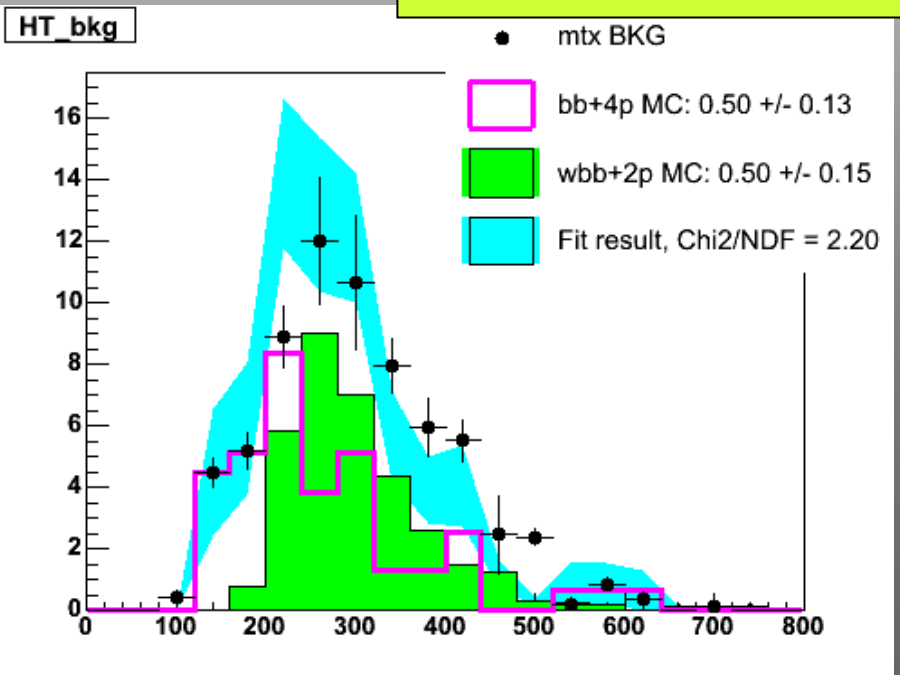
2-component fits to bkg

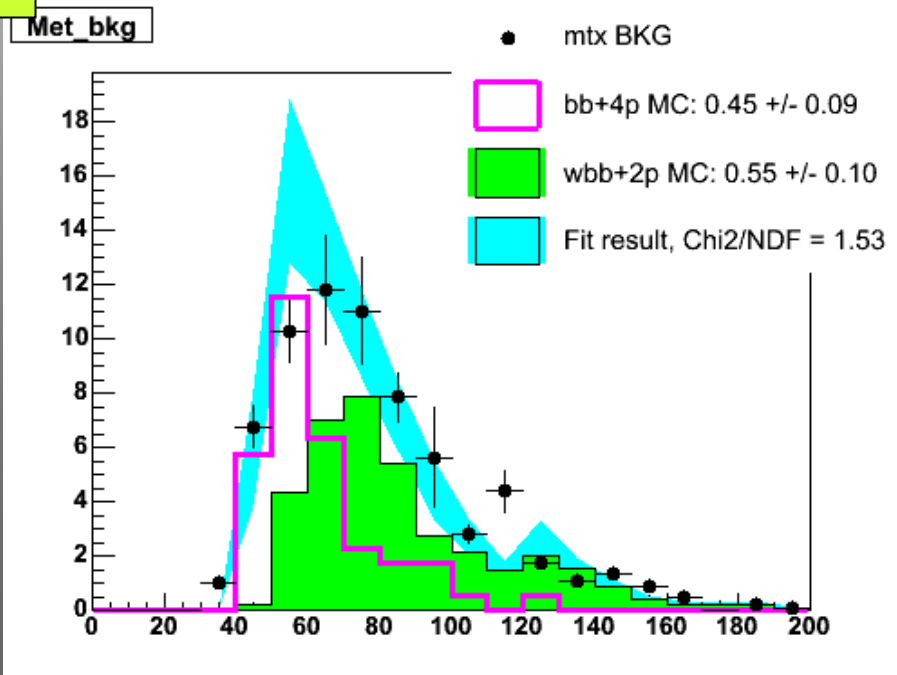
We can do more: we have the background shapes extracted from the tagging matrix information, we can fit them to the sum of two Alpgen Monte Carlo templates for the processes we expect to populate our signal region.

- Wbb+2P
- bb+4P

As before, the fits minimize a χ^2 that accounts for all templates statistical uncertainties.







2-component fits summary

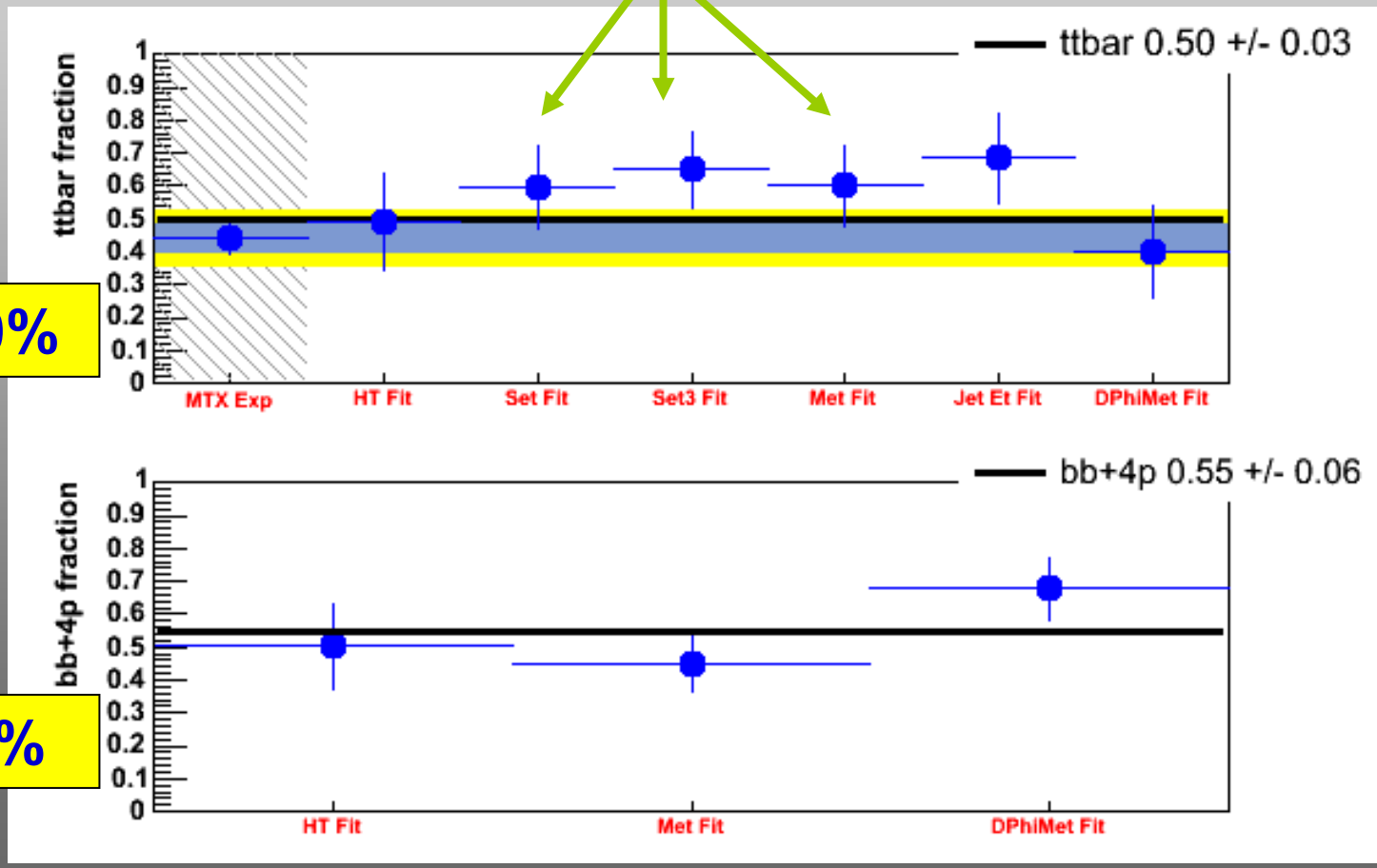
We have fitted both data and background using 2-c fits.

From data fits:

we found a ttbar fraction consistent with that calculated by the counting method.

$F_{top} \sim 50\%$

Note that some of the determinations are correlated with each other (HT, Sumet, Sumet3, met)



From bkg fits:

we found a bb fraction:

$F_{bb} \sim 55\%$

Conclusions

- We set up a 2-c fit technique in order to characterize the data sample after kinematical selection in terms of ttbar and background fractions.
- The results provided by fits are found to be consistent with the tag counting method (N_{jet} distribution), returning a ttbar fraction of 50% in the data sample after kinematical selection.
- On the other hand, the same procedure used to fit data can be applied to matrix derived templates. We fitted them to the sum of Wbb+jets and bb+jets from Alpgen+HERWIG Monte Carlo samples.
- Using the results of the fits we can estimate the background sample composition to be: 55% bb+jets and 45% Wbb+jets.
- Furthermore, background fits confirm the capability of our method-I matrix to account well for the main expected background processes.

After kin sel + ≥1 tag data: 50% top + ~27% bb + ~ 23% Wbb

Work status...

- **Almost done with systematic uncertainties determination, only ISR / FSR to be computed (waiting for prescriptions).**

- **The cross section measurement from this channel is right behind the corner.**

Systematics uncertainty sources

Source	Method	Uncertainty
ϵ_{kin} systematics		
Trigger simulation	turn-on curves	17.8 %
Generator dependence	$\frac{\lvert\epsilon_{PYTHIA}-\epsilon_{HERWIG}\rvert}{\epsilon_{PYTHIA}}$	8.2 %
PDFs	MC reweighting	1.6 %
ISR/FSR	samples comparison	N.A.
Jet Corrections	$\frac{\lvert\epsilon_{jetcorr,+1\sigma}-\epsilon_{jetcorr,-1\sigma}\rvert}{2\epsilon_{kin}}$	1.5 %
M_{top}	$\frac{\lvert\epsilon_{kin,M_{top}=170}-\epsilon_{kin,M_{top}=180}\rvert}{2*\epsilon_{kin,M_{top}=178}}$	2.8 %
ϵ_{tag} systematics		
SecVtX scale factor	$\frac{\lvert\epsilon_{tag,+1\sigma}-\epsilon_{tag,-1\sigma}\rvert}{2\epsilon_{tag}}$	5.5 %
Tagging matrix systematics		
Data control samples	N_{obs}/N_{exp}	10.0 %
Luminosity systematics		
Luminosity measurement	–	6.0 %

CDF-7473

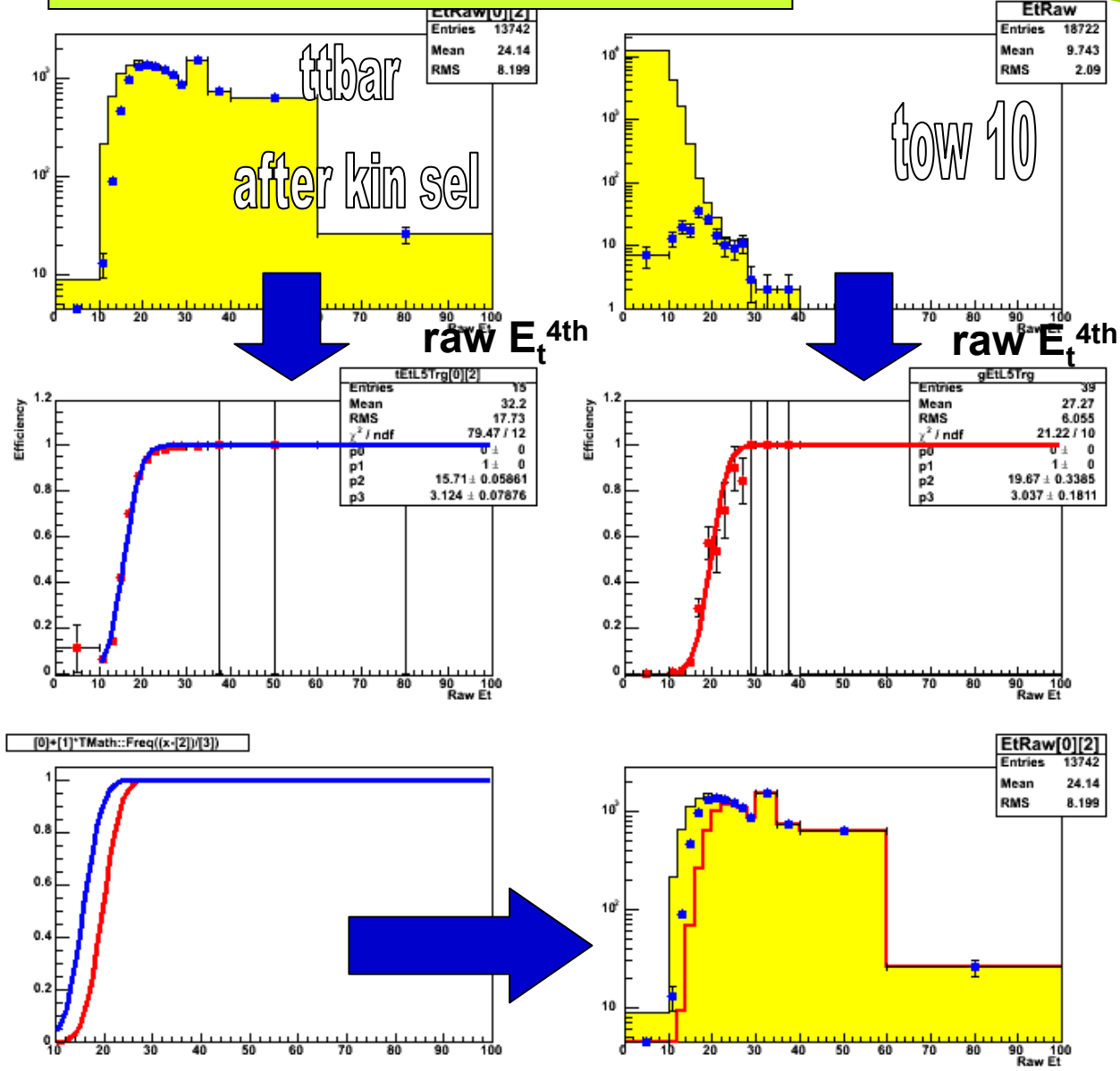
... and plans

- **Write down/update supporting CDF-notes.**
- **The plan is to go straight ahead for a full status report for June 17th 2005.**

A bit more on systematics: Trigger

Trigger efficiency on signal events is determined using TRIGSIM++.

CDF-7473



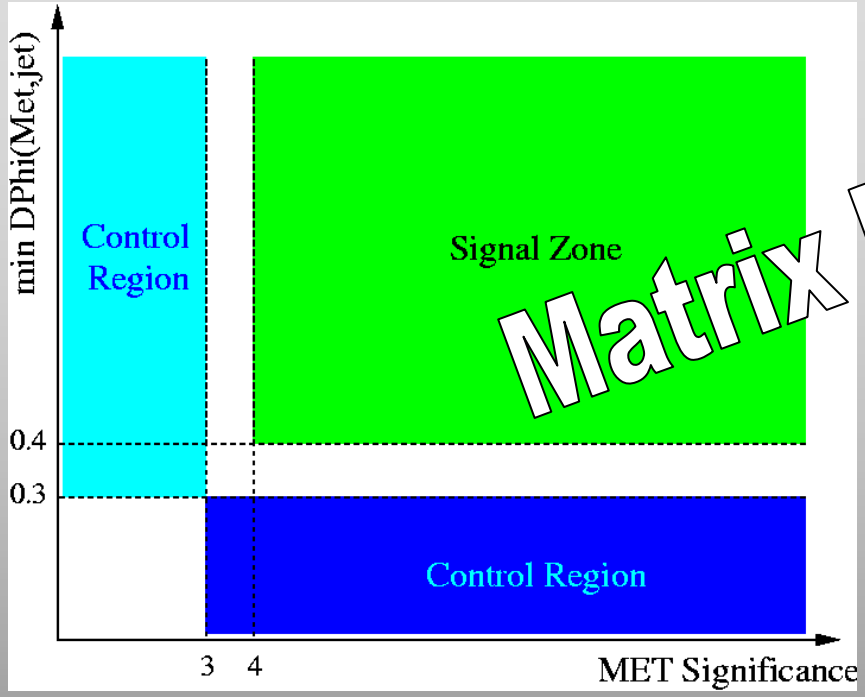
Need to evaluate related systematic:

comparing trigger turn-on curve (as a function of some offline variable) as returned by the simulation and as measured from Tower 10 data (same L1 as TOP_MULTI_JET).

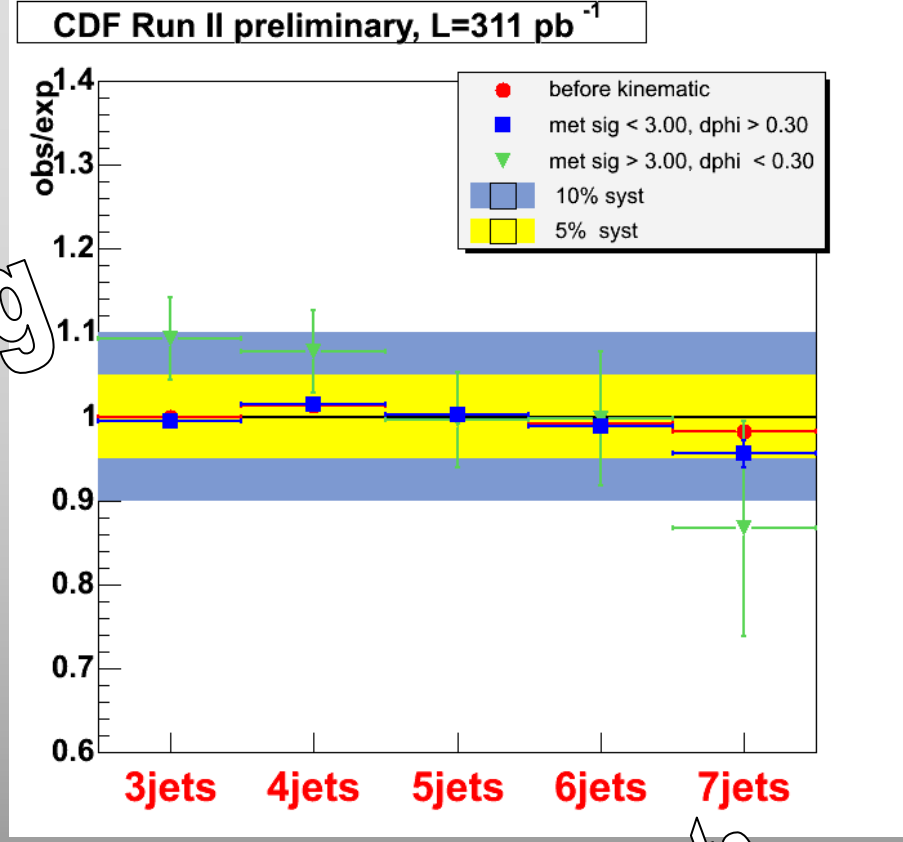
The mismatch between turn-on curve allows to quantify the systematic effect.

Note: the 4th offline jet is matched with the 4th L2 cluster within R=0.4 in order to preserve energy hierarchy

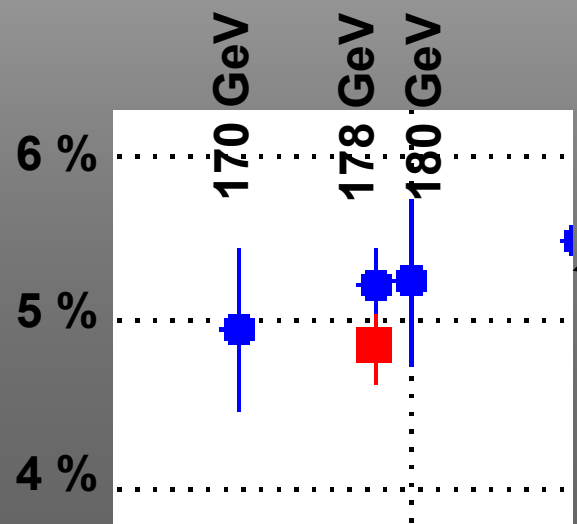
A bit more on systematics:



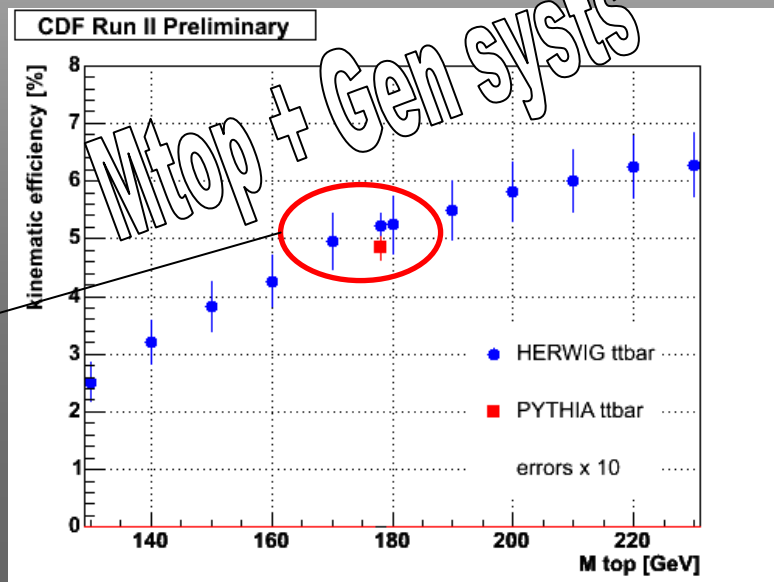
Matrix bkg



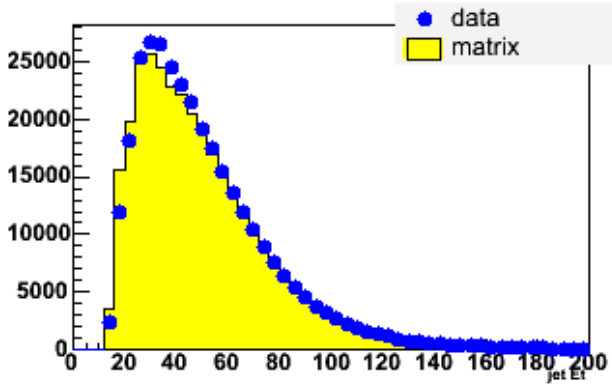
Other systematic uncertainty sources are evaluated by comparing signal kin and tagging efficiencies obtained with ±1σ variation of standard quantities

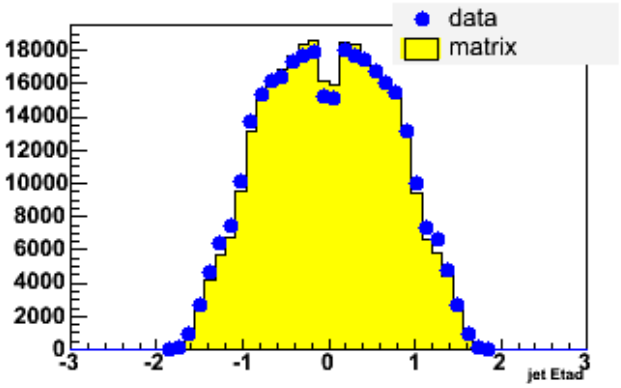


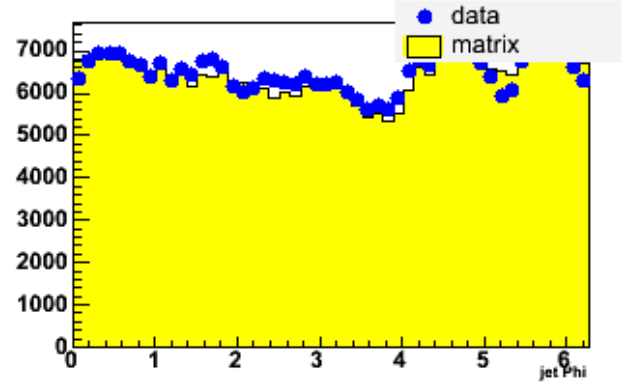
Mtop + Gen systs

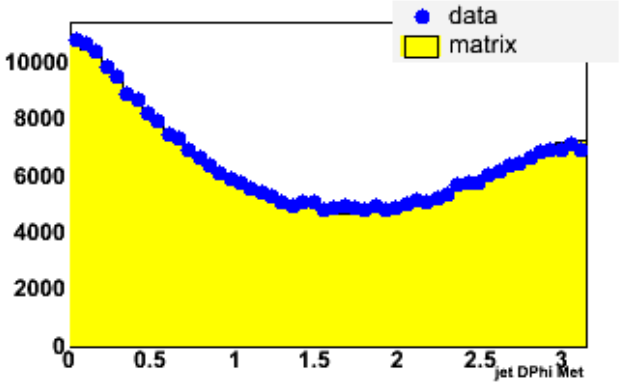


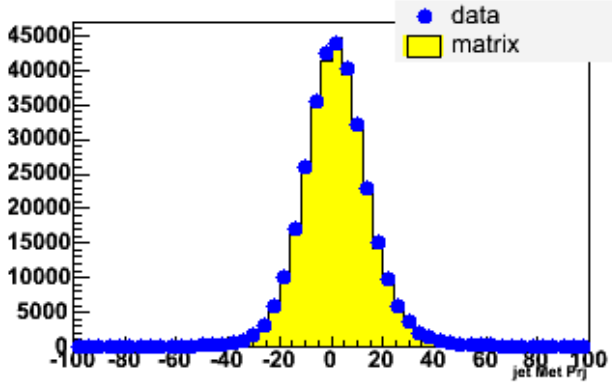
Backup Slides







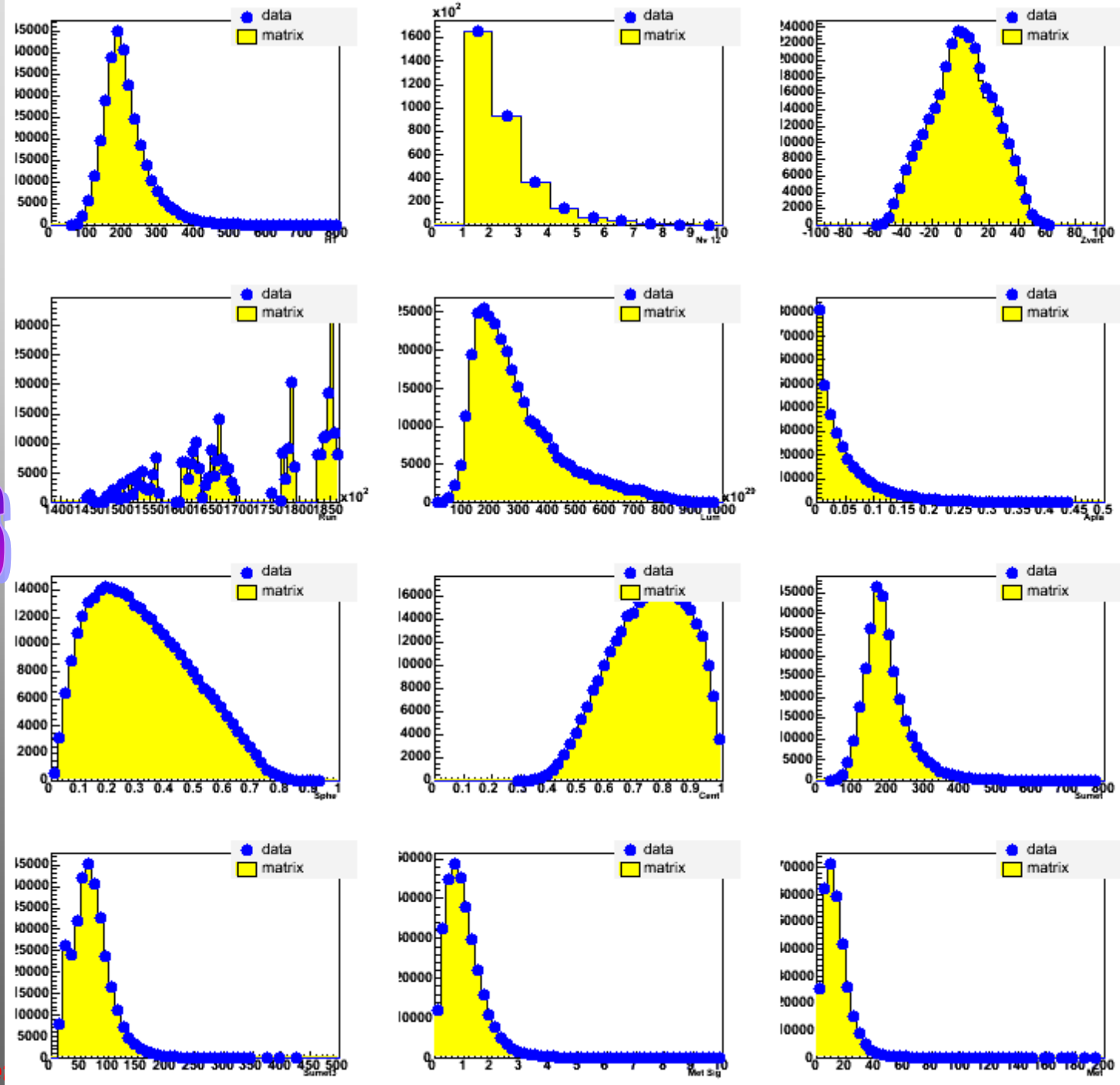




Jet variables

Tagging matrix based kinematical distribution compared to data ones before kinematical selection

Tagging matrix based kinematical distribution compared to data ones before kinematical selection



Evt variables