

# *Underlying Event @ CMS*

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# Summary

- Results and performances on UE variable measurement using CMS (CMS NOTE 2006/067)
- Comparison of different Pythia tune (ATLAS, DWT, DW, A) with the UA5 data
- Prediction for the first run of LHC @ 900 GeV

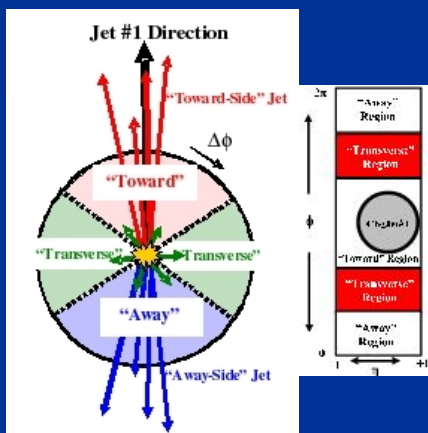
# Strategies for UE measurement at LHC



## Charged Jet:

Topological structure of p-p collision from charged tracks.

Charged jet definition -> ICA algorithm with massless charged tracks as input



The most energetic charged Jet define a direction in the  $\phi$  plane  
 The transverse region is particularly sensitive to the UE

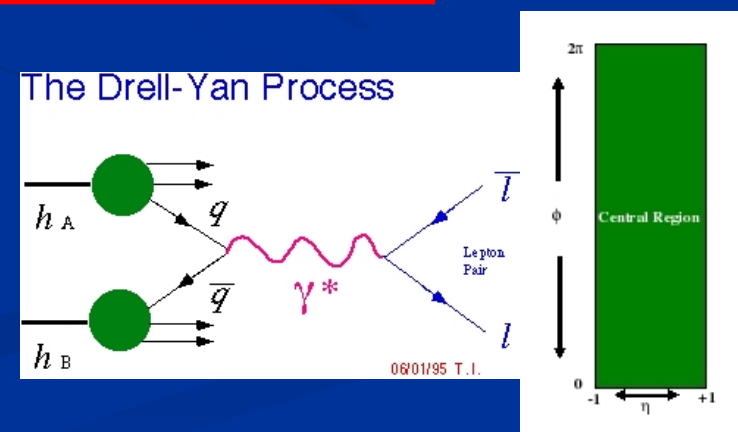
## Main observables:

- $dN/d\eta d\phi$ , charge density
- $d(PT_{\text{sum}})/d\eta d\phi$ , energy density

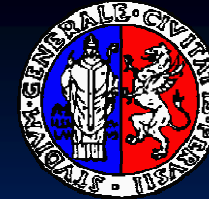
## From D-Y muon pair production:

observables are the same but defined in all the  $\phi$  plane

(after removing the  $\mu$  pairs everything else is UE)



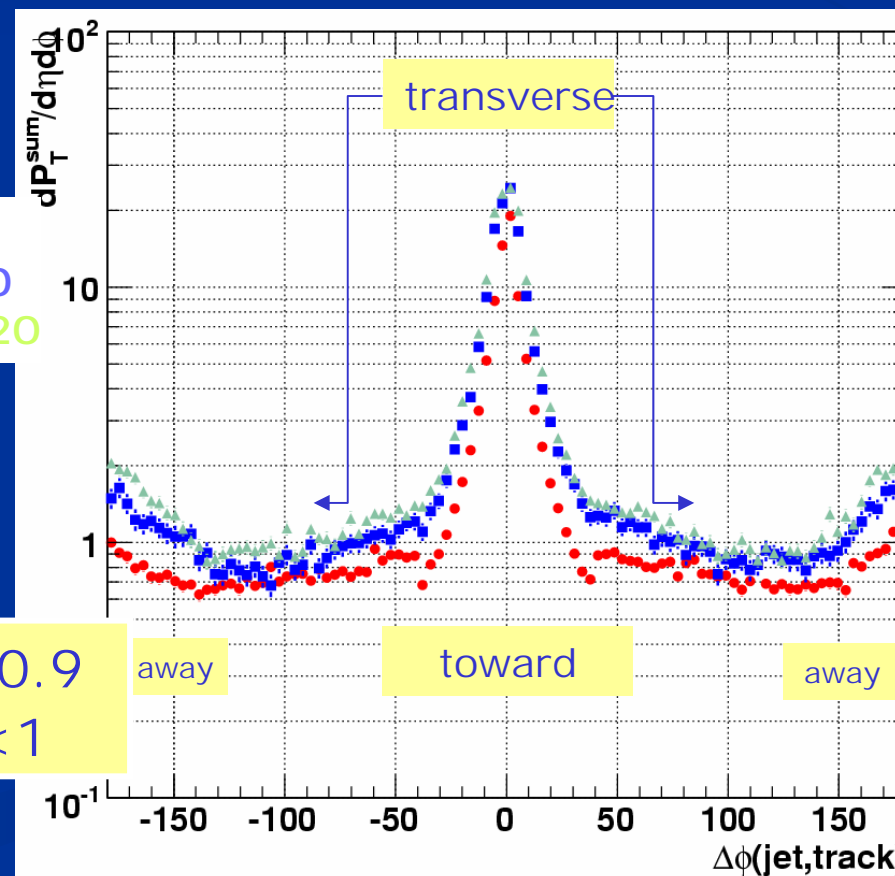
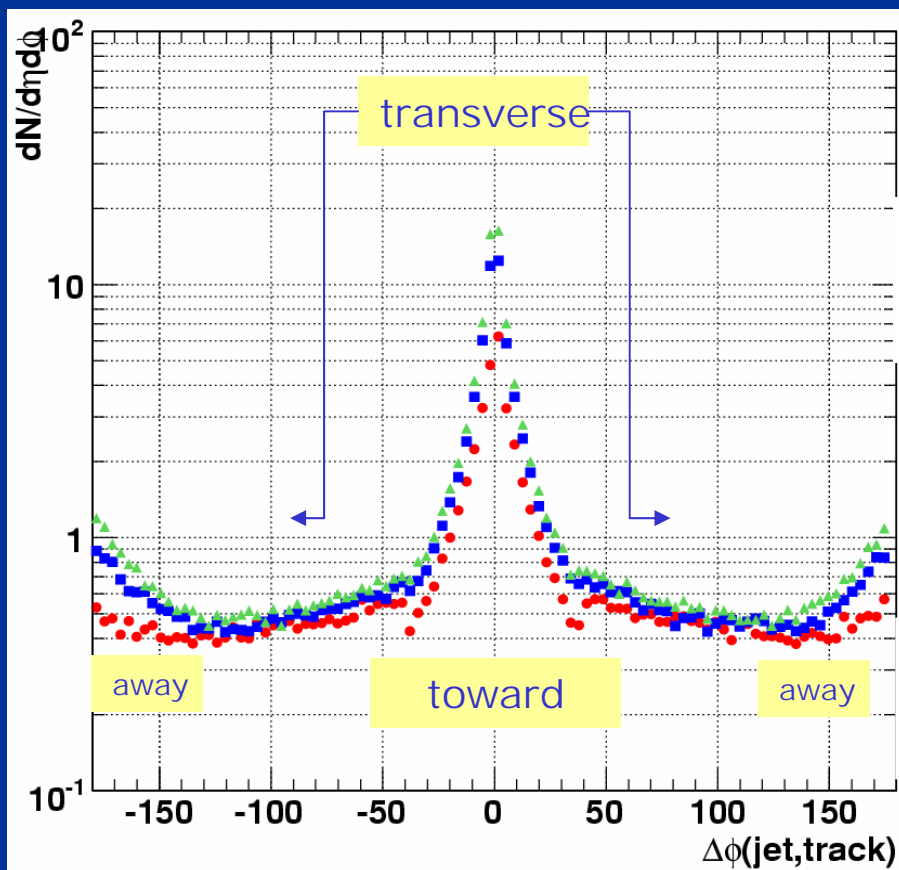
# Density distribution (full simulation)



## Charged Jet

$dN_{ch}/d\eta d\phi$  VS  $\Delta\phi$

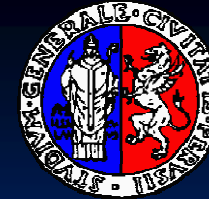
$dP_{T\text{sum}}/d\eta d\phi$  VS  $\Delta\phi$



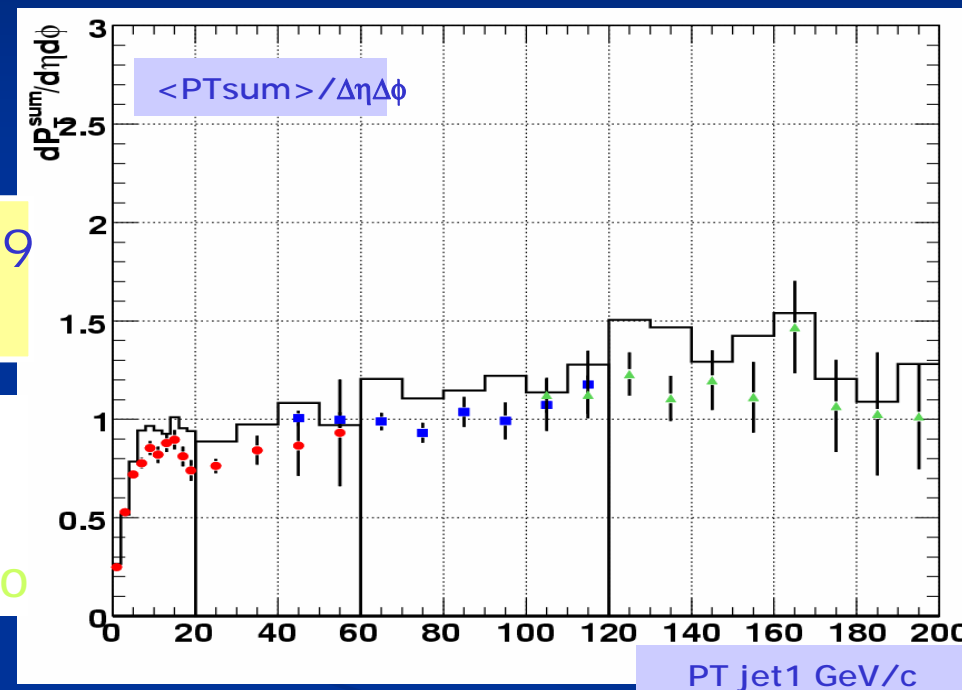
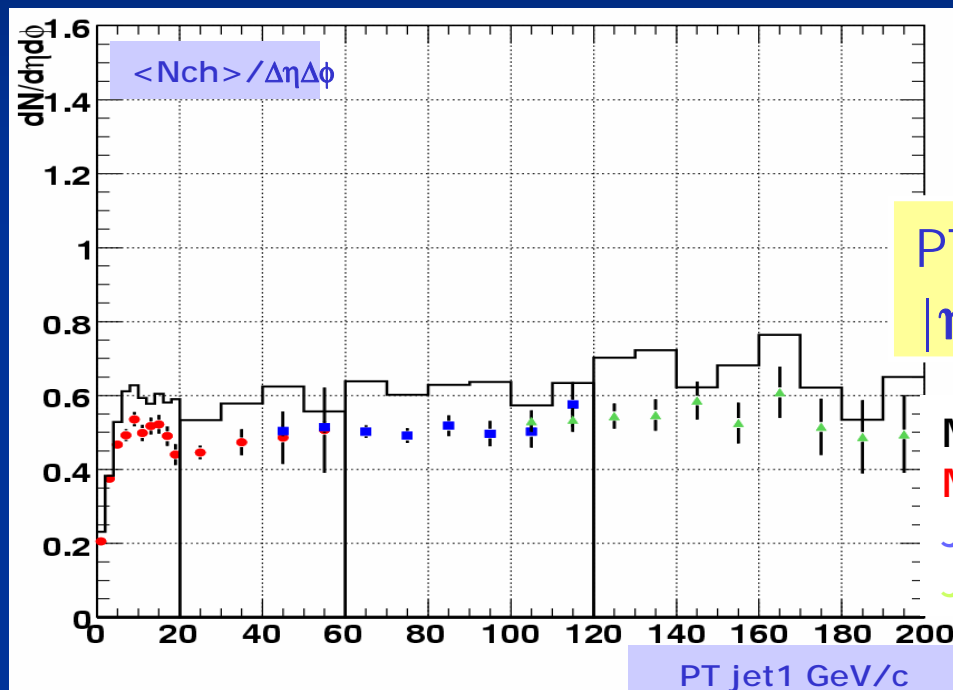
MB  
JET60  
JET120

$P_T > 0.9$   
 $|\eta| < 1$

# Transverse region (full simulation)

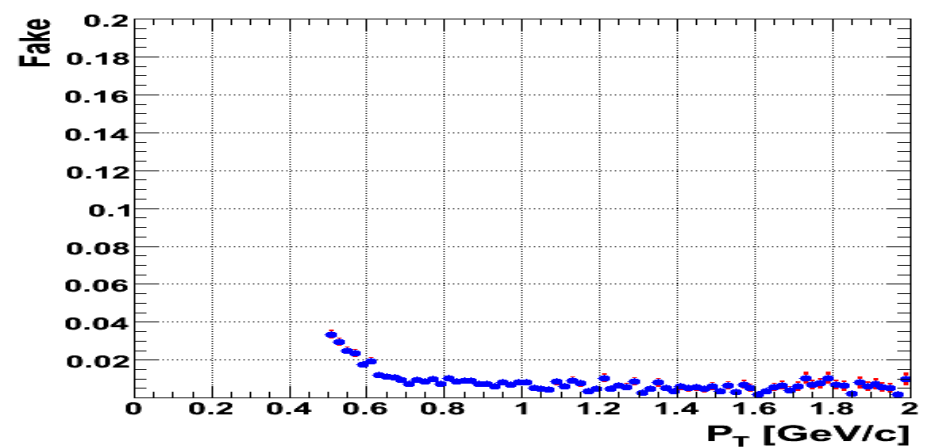
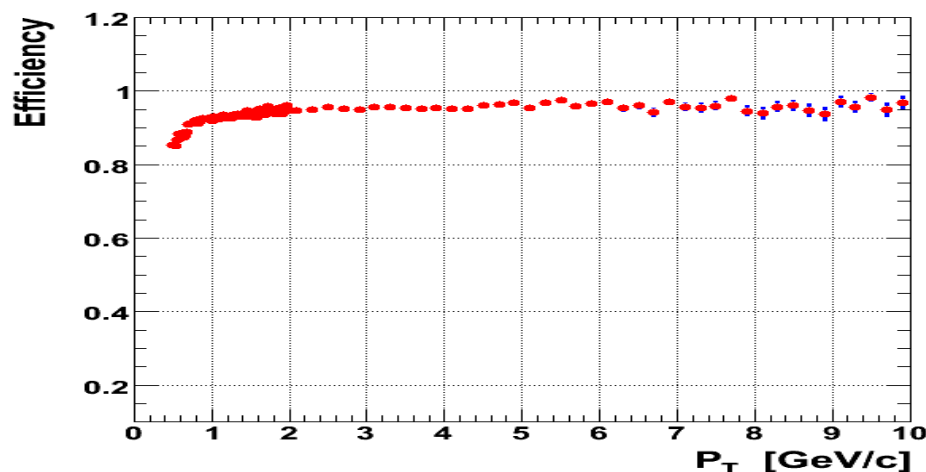
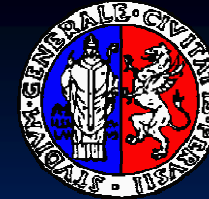


## Charged Jet

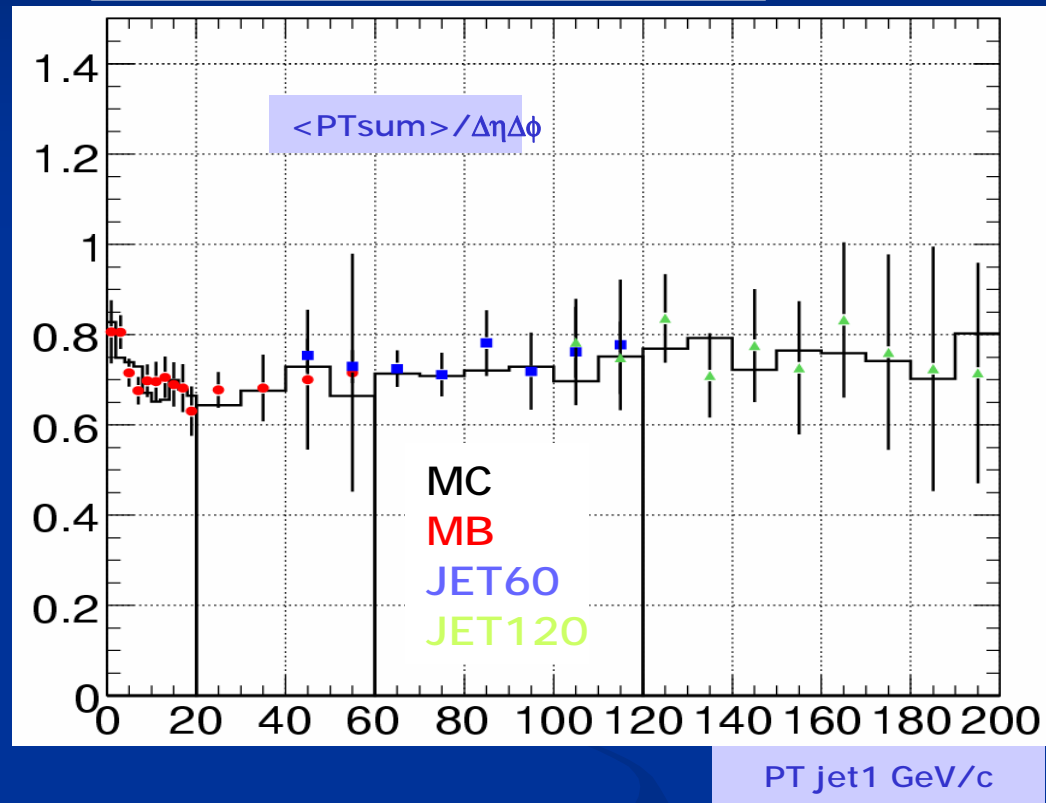


Events re-weighted with corresponding x-sec  
(error bars dominated by MC statistics, arbitrary luminosity but scaling correctly)  
Good RECO/MC agreement in shape  
Differences compatible with the expected corrections  
from charged jet PT calibration, charged tracks inefficiencies and fake rate

# Transverse region (full simulation)



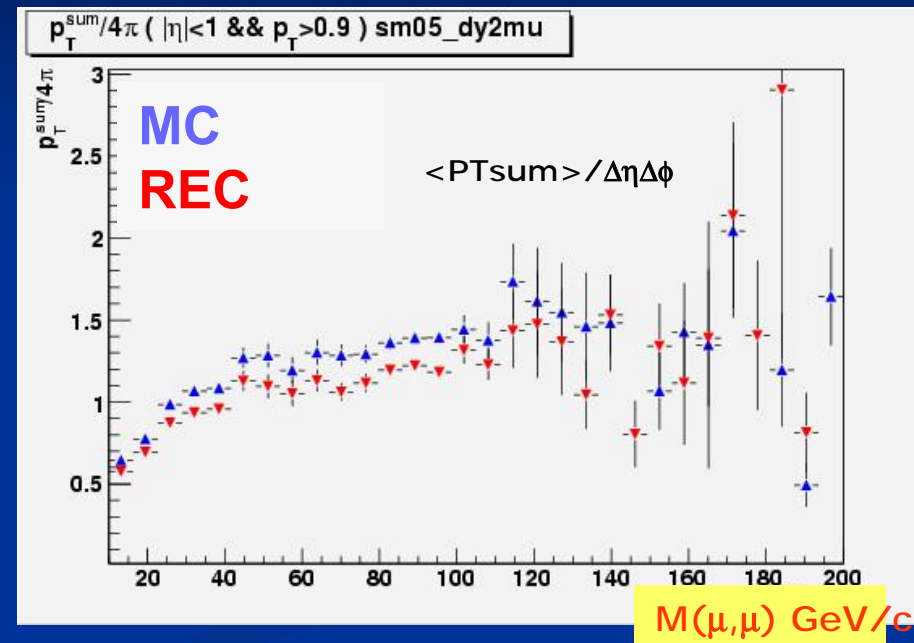
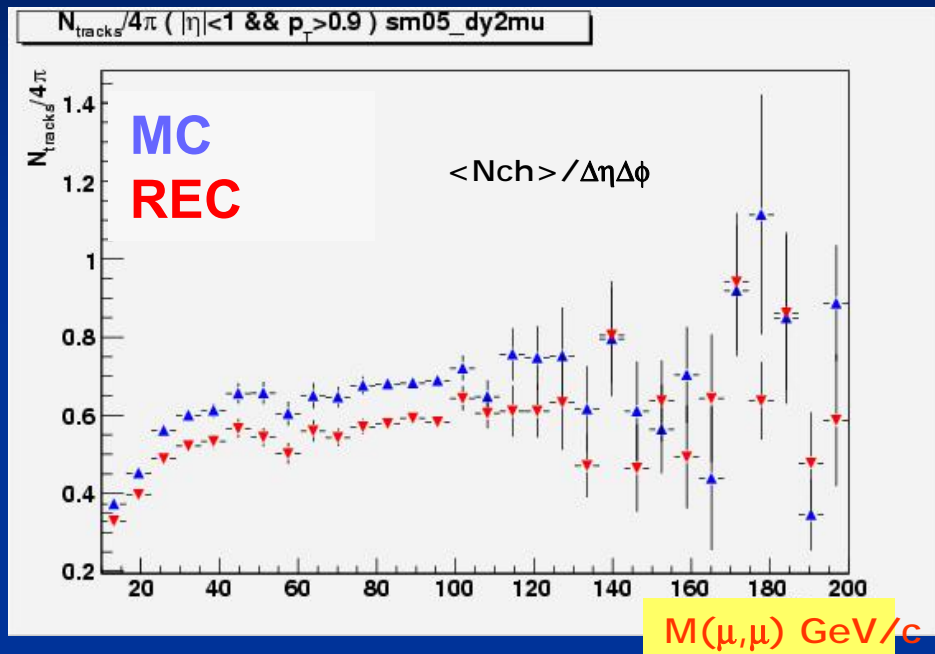
Ratio  $PT > 0.9 / PT > 05 \quad |\eta| < 1$



Really Good RECO/MC agreement.

RECO/MC Differences absorb in the ratio, no need to apply corrections.

# Transverse region (Drell-Yan)



Lack of statistics for  $M(\mu,\mu)$  out of Z mass peak.

(error bars dominated by MC statistics, arbitrary luminosity but scaling correctly)

Good agreement with MC prediction:

differences compatible with expected corrections from dimuon mass calibration, efficiency of charged track reconstruction and fake rate.



# Pythia setup

## PYTHIA 6.227 CTEQ5L

Parameter	Tune A	Tune DW	Tune DWT	ATLAS
MSTP(81)	1	1	1	1
MSTP(82)	4	4	4	4
PARP(82)	2.0 GeV	1.9 GeV	1.9409 GeV	1.8 GeV
PARP(83)	0.5	0.5	0.5	0.5
PARP(84)	0.4	0.4	0.4	0.5
PARP(85)	0.9	1.0	1.0	0.33
PARP(86)	0.95	1.0	1.0	0.66
PARP(89)	1.8 TeV	1.8 TeV	1.96 TeV	1.0 TeV
PARP(90)	0.25	0.25	0.16	0.16
PARP(62)	1.0	1.25	1.25	1.0
PARP(64)	1.0	0.2	0.2	1.0
PARP(67)	4.0	2.5	2.5	1.0
MSTP(91)	1	1	1	1
PARP(91)	1.0	2.1	2.1	1.0
PARP(93)	5.0	15.0	15.0	5.0

## PROCESS LIST

MSEL	0
MSUB(11)	1
MSUB(12)	1
MSUB(13)	1
MSUB(28)	1
MSUB(53)	1
MSUB(68)	1
MSUB(94)	1
MSUB(95)	0
MSUB(92)	0
MSUB(93)	0

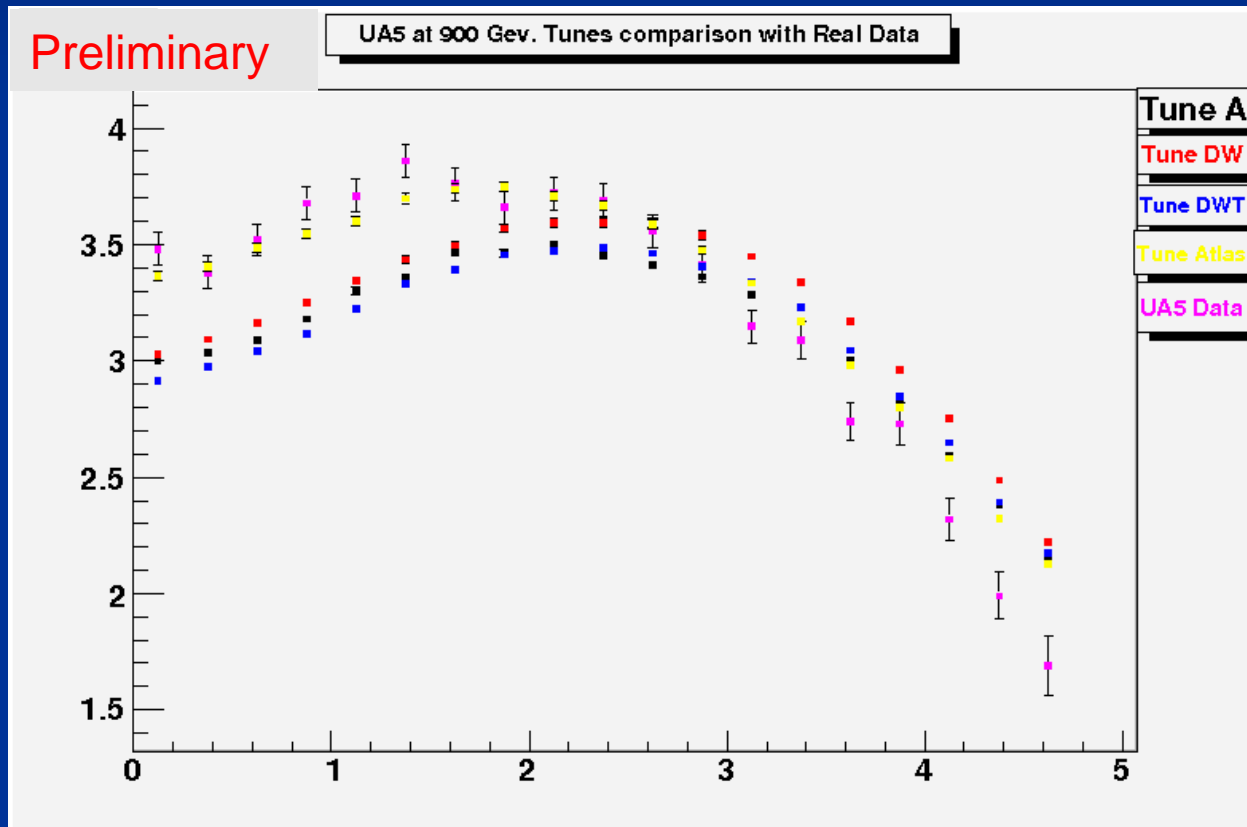
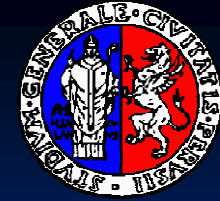
Switched off by error the low pt :-)

We have made a test and no sensible differences appear in the distributions

No single diffractive process included



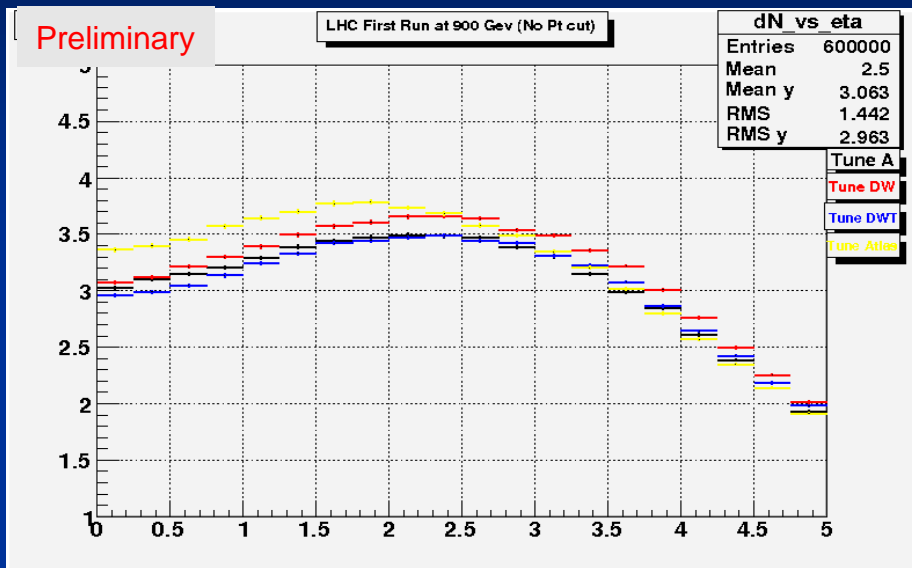
# UA5 multiplicity data compared with Pythia tunes



- This results are in agreement with what already presented by Rick on different track multiplicity prediction from the Rick's tune and the ATLAS Tune see pag 47 of today presentation of Rick

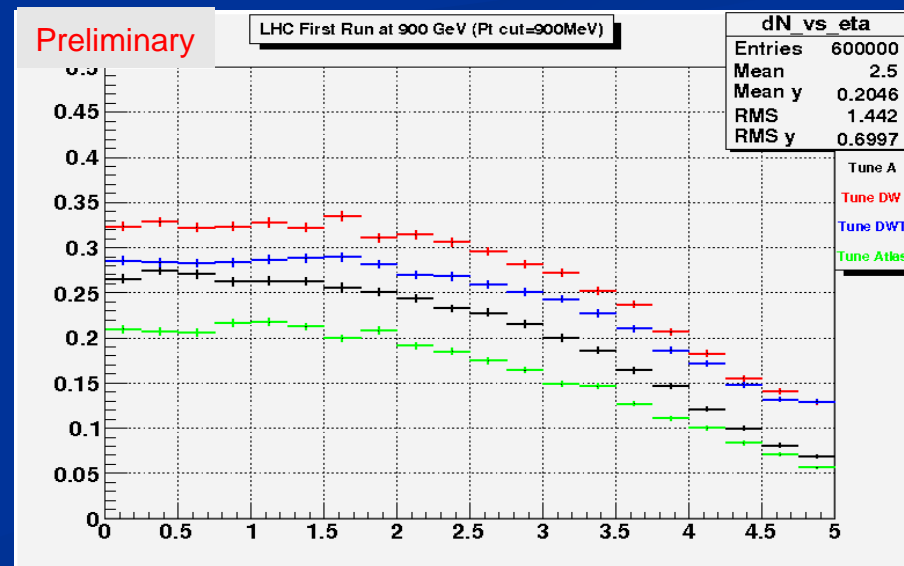
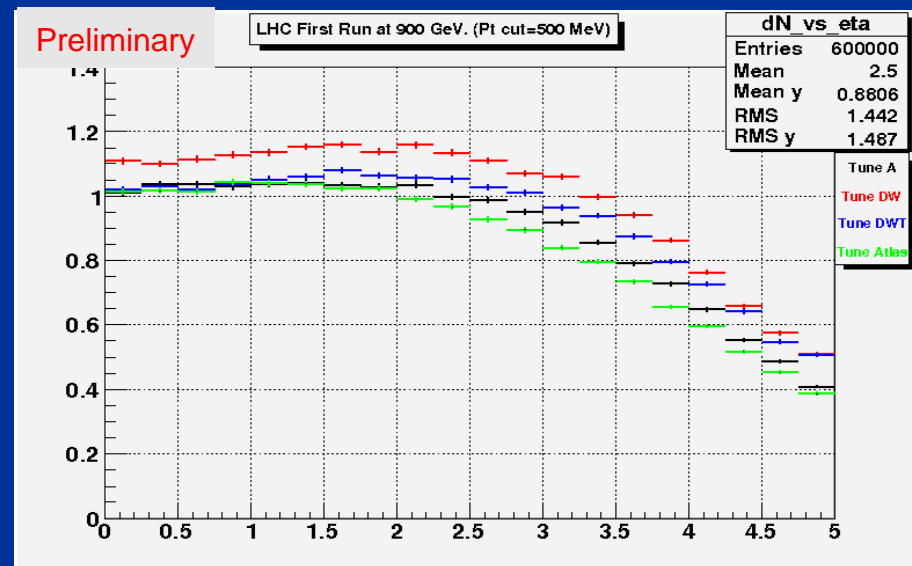
# LHC start up (pp @ 900GeV)

## conditions $dN_{chg}/d\eta$



Looking these plot we can see that the ATLAS tune predict more soft track wrt the other tunes (A, DW, DWT)  
Fix the  $\eta$  value = 0 we have:

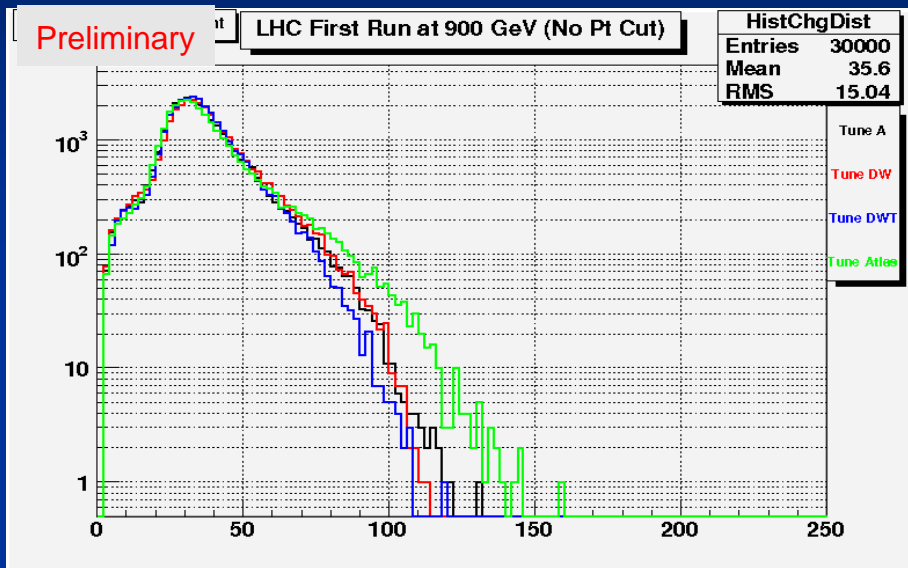
PT Cut	Tune ATLAS	TuneDWT
0	~3.4	~3
500 MeV	~1	~1
900 MeV	~0.22	~0.29



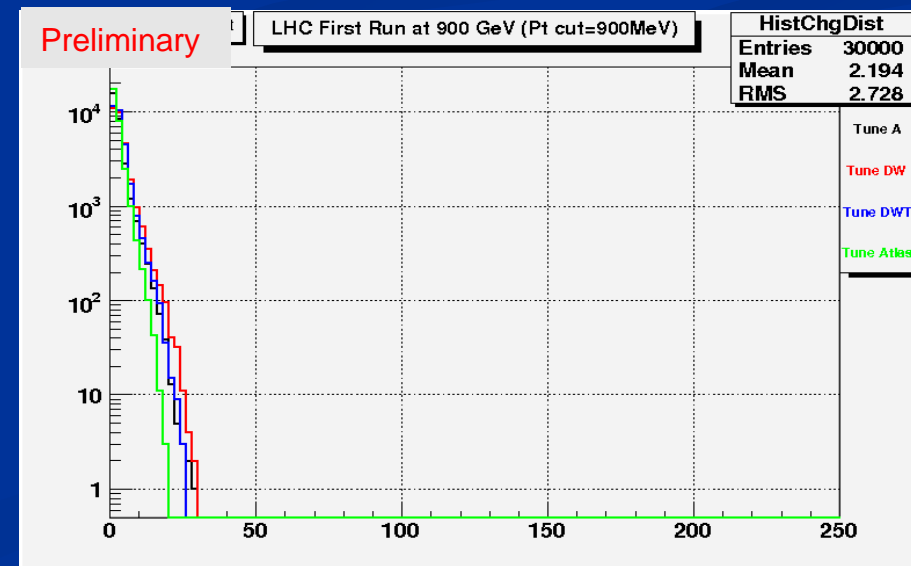
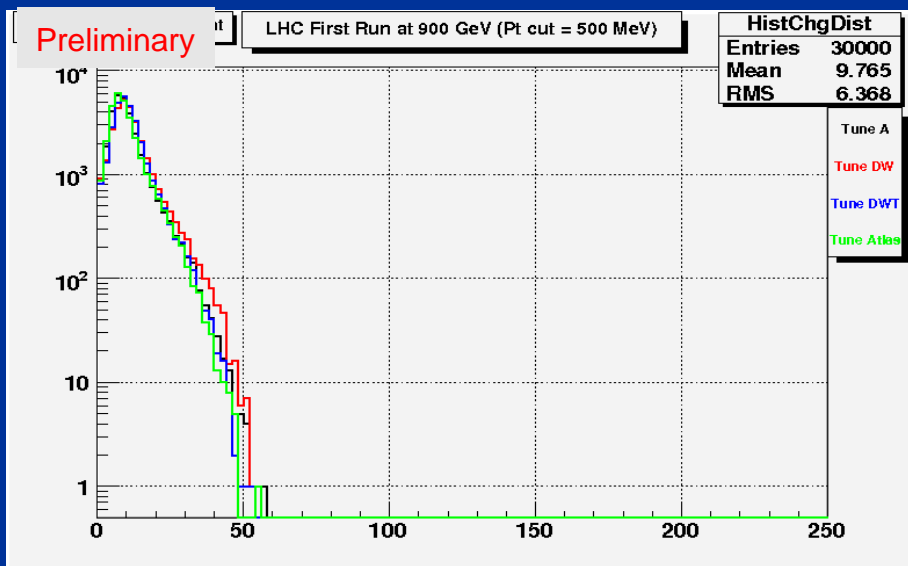
# LHC start up (pp @ 900 GeV) conditions $N_{chg}$



Also in these plot we can see that the ATLAS tune has an higher multiplicity wrt the other tunes (A, DW, DWT), but is also relevant how rapidly decrease the MPV of Nchg track applying a Pt cut



PT Cut	MPV Nchg
0	~35
500 MeV	~10
900 MeV	~2





# Conclusion

- Full reconstruction study with CMS. CMS-Note 2006/067
- Possibility to go to 500 MeV as minimum pt for track reconstruction → absorption of some of the syst. Uncertainties connected to track reco.
- Study at generator level on comparing the results with the UA5 charged multiplicity data (LHC start-up conditions will be pp @ 900 GeV)
  - PRELIMINARY