ϕ, ρ and ω production in Pb-Pb collisions at 158 GeV/n

('96 NA50 data and preliminary results)

NA50 Collaboration

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OUTLINE

1) Experimental features
   →Measurements
   →Simulations
   →Extraction of data ⇒ Extraction of ϕ, ρ, ω components

2) ϕ enhancement

→ ϕ/(ρ+ω) ratio studies versus centrality for different M_t bins

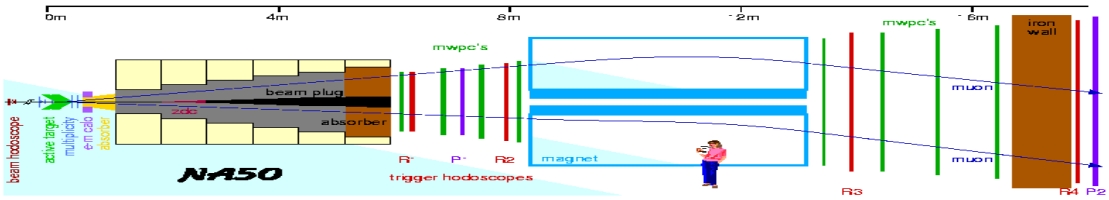
→Multiplicity studies for ϕ and ρ+ω resonances for different M_t bins

3) cross sections

→ extraction of T for ϕ and ρ+ω resonances

CONCLUSIONS

EXPERIMENTAL SET-UP AND DATA ANALYSIS



- NA50 Ψ set-up presented in plenary session
- No optimisation for low mass region
  →Significant acceptance for $M_t > 1.5$ GeV/c^2

- Range for 5 kinematical variables

Rapidity	$0.<Y_{CM}<1.$
Angles: φ, θ(C.S)	$0.<\varphi^*<2\pi$
	$-0.5<\cos\theta^*<0.5$
Transverse Mass	
	$1.5<M_t<3.2.$ GeV/c^2
Mass	<2 GeV/c^2

DATA ANALYSIS

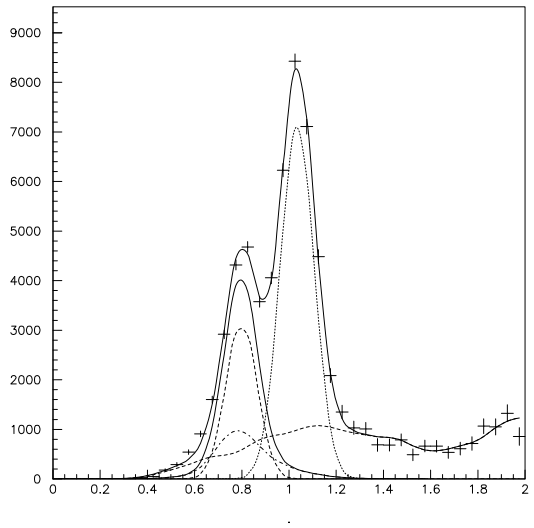
- Data taking I~ 5. 10^7 Pb/burst → L~ 4. 10^{12}
  ($\mu^+\mu^-$) statistics: 1. 10^6
- Background subtraction

$$N^{\mu^-\mu^+}_{\text{signal}} = N^{+-} - 2\sqrt{(N^{++}N^{--})_+} - 2\sqrt{(N^{++}N^{--})_-}$$

→Typical mass spectra

→Reconstructed ϕ: ~ 130000 (exp)

3 regions for the simulation adjustments



(A) (C): "continuum"
0.25 <M<0.65 (GeV/c^2)
1.4 <M<1.8 (GeV/c^2)

(B): "resonances region"
0.65 <M< 1.2 (GeV/c^2)

Signal in (B): 27%
Continuum in (B): 14 to 31%
Mass resolution: ≈70 MeV/c^2

- 5 Transverse mass bins M_t
- 9 transverse energy bins E_t
- Use of (E_t-E_{zdc}) correlation

SIMULATIONS

Adjustments of source distributions on experiment :
For each variable and component, in the corresponding mass region

Mt as example

→Phenomenological first generation function depending on a parameter T:

$$\left(\frac{dN}{dM_t}\right)_{gen.} \propto M_t^2 \, K_1(M_t / T)$$

→Reconstruction of events $\rightarrow f_{cor}(M_t) = \dfrac{\left(\frac{dN}{dM_t}\right)_{exp.}}{\left(\frac{dN}{dM_t}\right)_{reconst.}}$

→Apply $f_{cor}(M_t)$ to the generation function → fit

→New temperature T→new generation function
→Iteration of the process→ $f_{cor}(M_t)$ as flat as possible
→ stable parameter T

RESONANCES

♦Rapidity distributions: $dN/dY_{\mu} \propto \exp(-Y_{\mu\mu}^2/2\sigma^2)$

♦Mass distributions ϕ, ω : Breit-Wigner shapes

ρ resonance :

$$B_{\rho}(M) = \sigma(M).\ BW(M)$$

σ(M) related to the non resonant background (phase space) under $\rho \rightarrow \pi\pi$

♦Transverse mass distributions (Hagedorn)

$$\left(\frac{dN}{dM_t}\right)_{gen.} \propto M_t^2\, K_1(M_t/T)$$

CONTINUUM

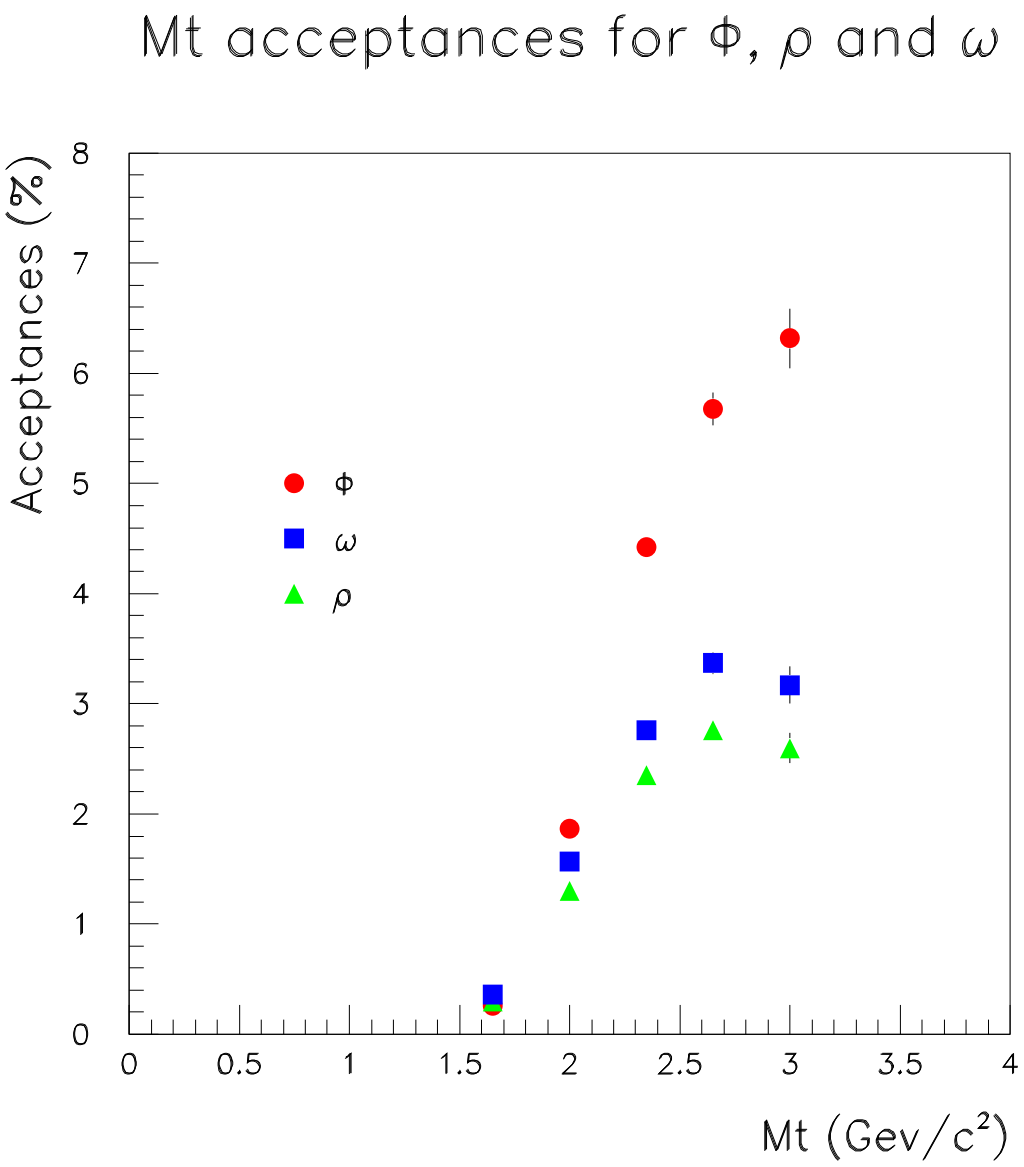
♦Rapidity distributions: $dN/dY \propto \exp(-Y_{\mu\mu}^2/2\sigma^2)$

♦Mass and transverse mass:

$$\left(\frac{dN}{dM}\right)_{gen.} = \frac{1.}{M^{\alpha}} \exp(-M/\beta)$$

$$\left(\frac{dN}{dM_t}\right)_{gen.} \propto M_t^2\, K_1(M_t/T)$$

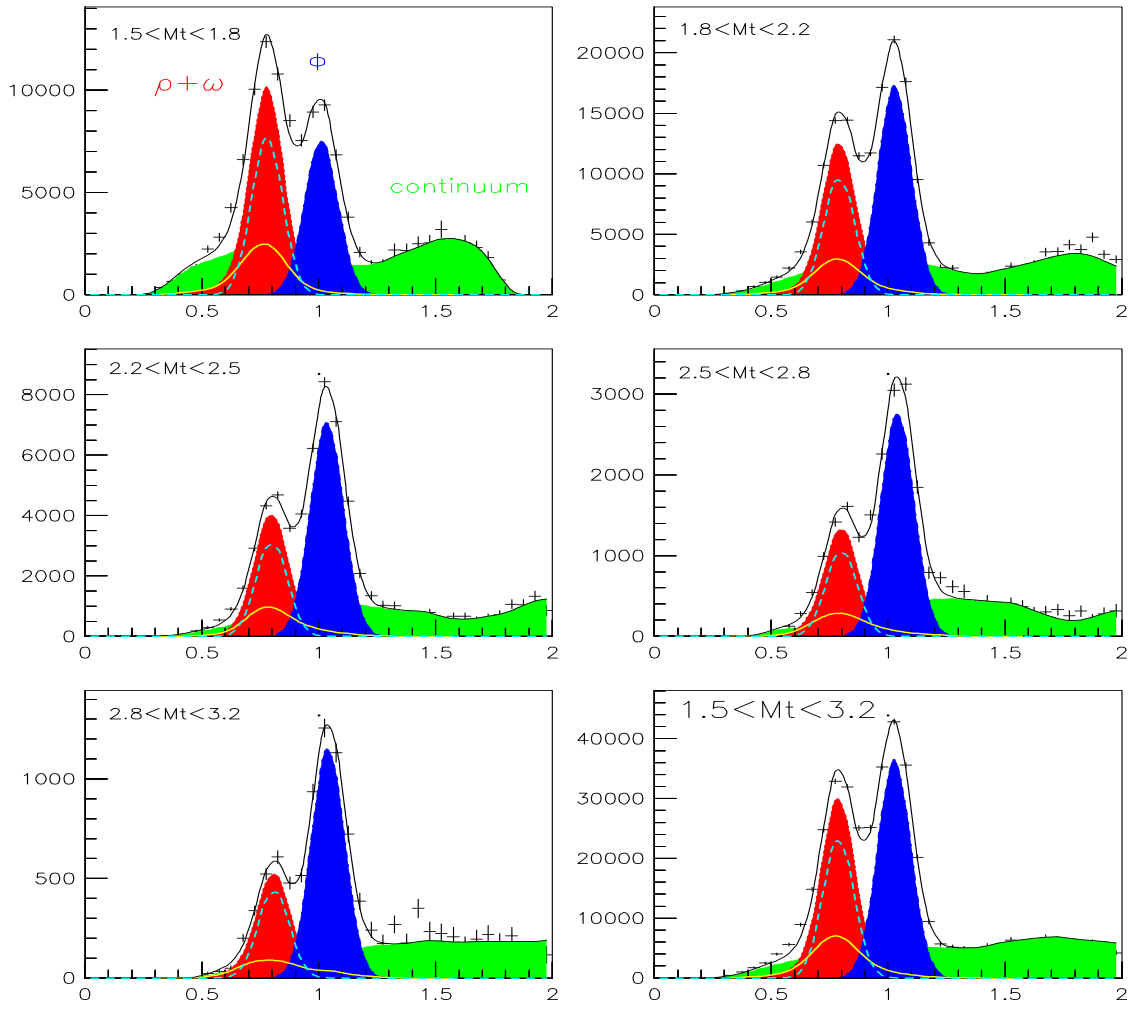
ACCEPTANCES for various M_t BINS



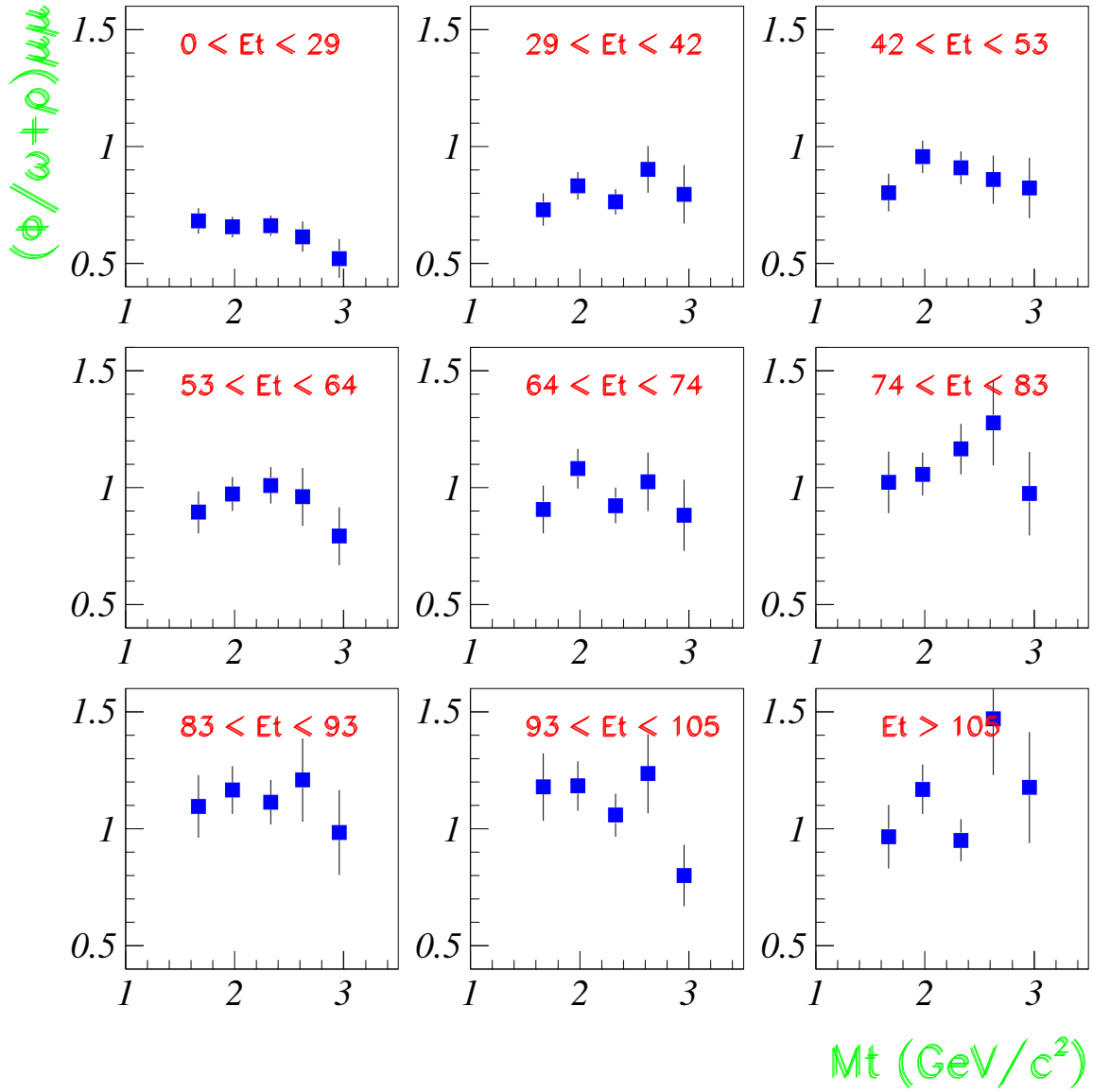
EXPERIMENTAL RESULTS

$$\frac{dN}{dM_{\mu\mu}} = A_{\rho+\omega}\left(F_{\rho}(M_{\mu\mu}) + R.F_{\omega}(M_{\mu\mu})\right) + A_{\Phi}F_{\Phi}(M_{\mu\mu}) + A_{CNT}F_{CNT}(M_{\mu\mu})$$

5 free parameters: 3 amplitudes A and ϕ, ω mass positions

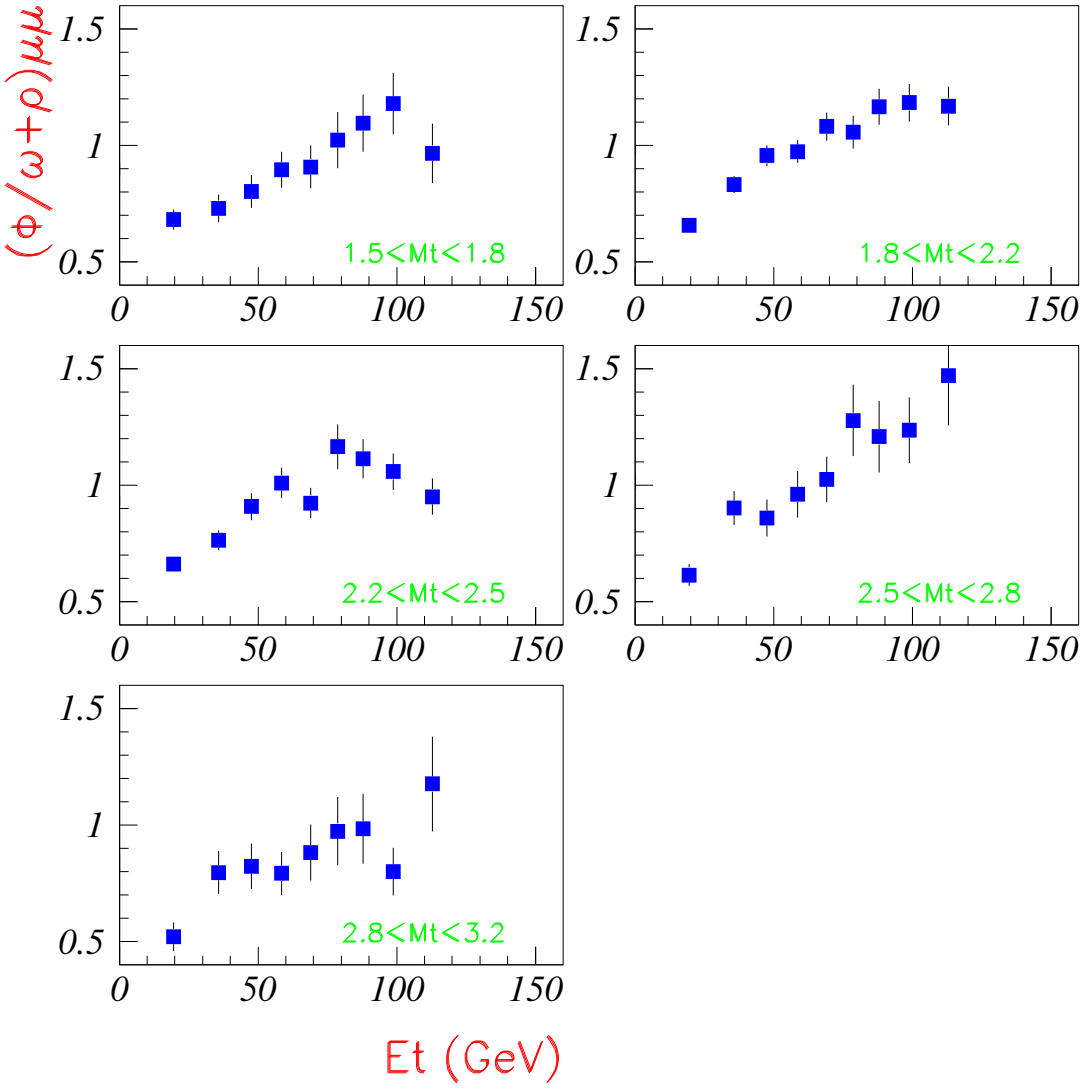


ϕ/(ρ+ω) RATIOS versus M_t



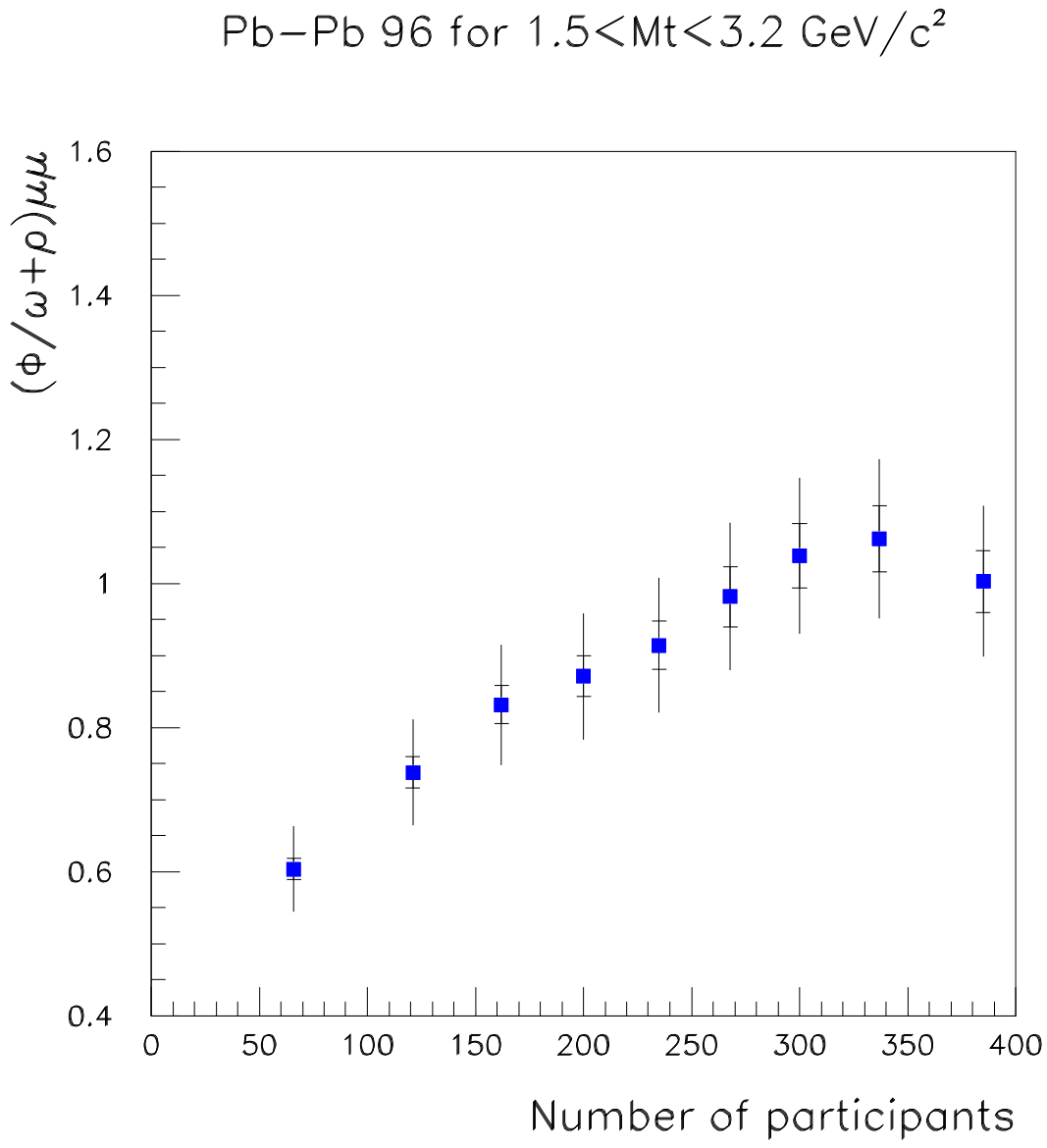
⇒ Similar behaviour in M_t variables for ϕ, ρ+ω

ϕ/(ρ+ω) RATIOS versus E_t for ≠Mt bins



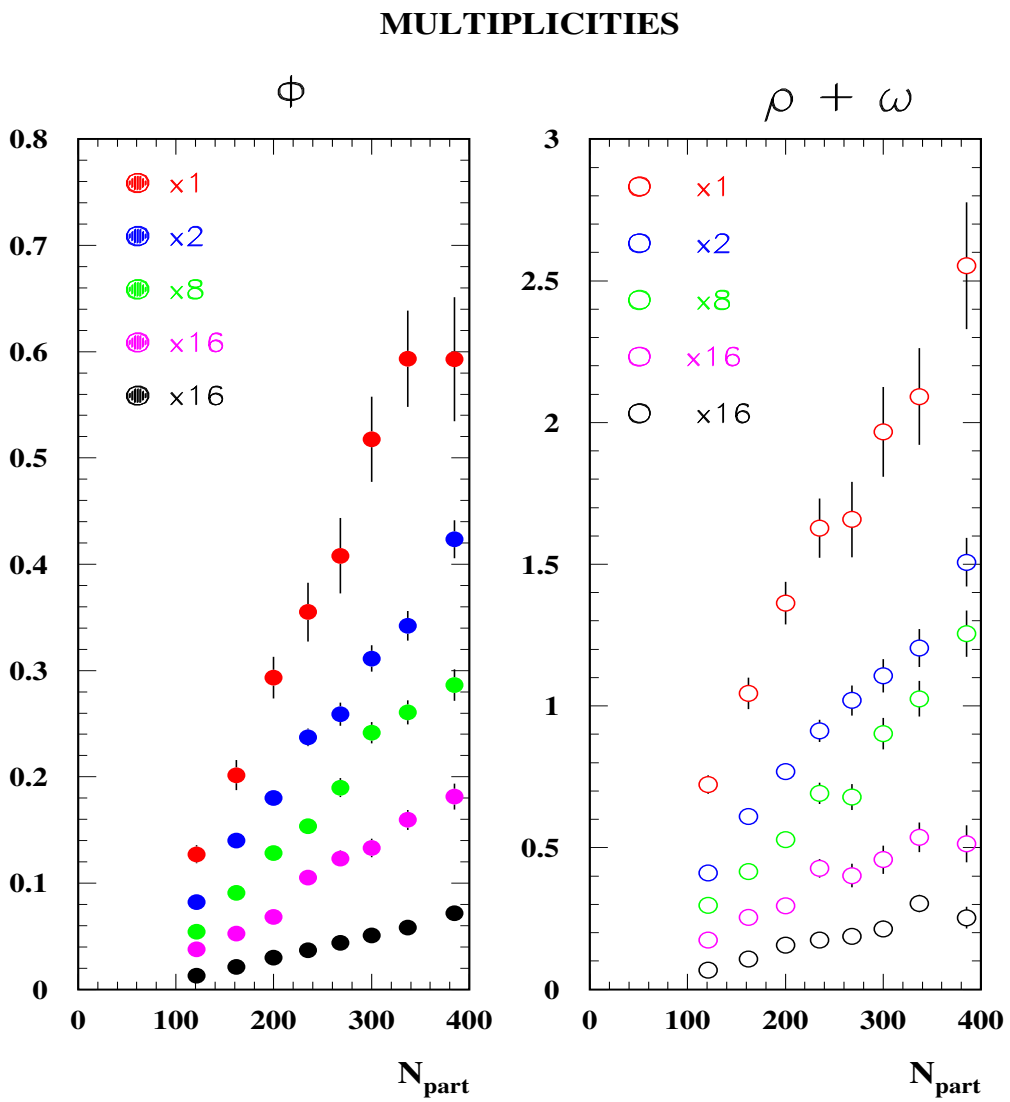
⇒Increase of ϕ/(ρ+ω) as function of centrality

φ/(ρ+ω) RATIO (ALL M_T BINS)



Smooth increase as function of centrality

MULTIPLICITY STUDIES FOR ≠ M_t BINS



1.5 < Mt < 1.8 GeV/c^2

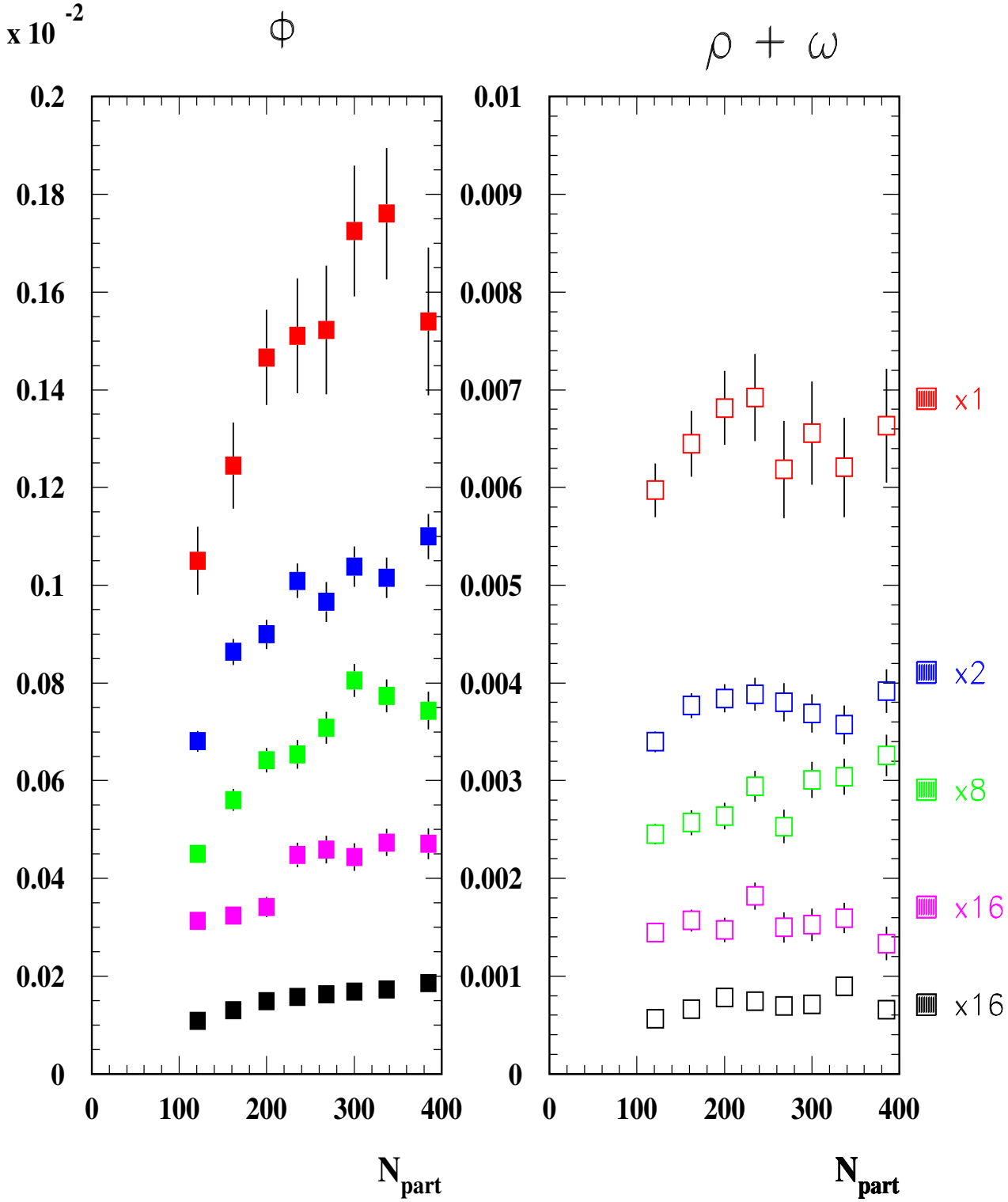
1.8 < Mt < 2.2 GeV/c^2

2.2 < Mt < 2.5 GeV/c^2

2.5 < Mt < 2.8 GeV/c^2

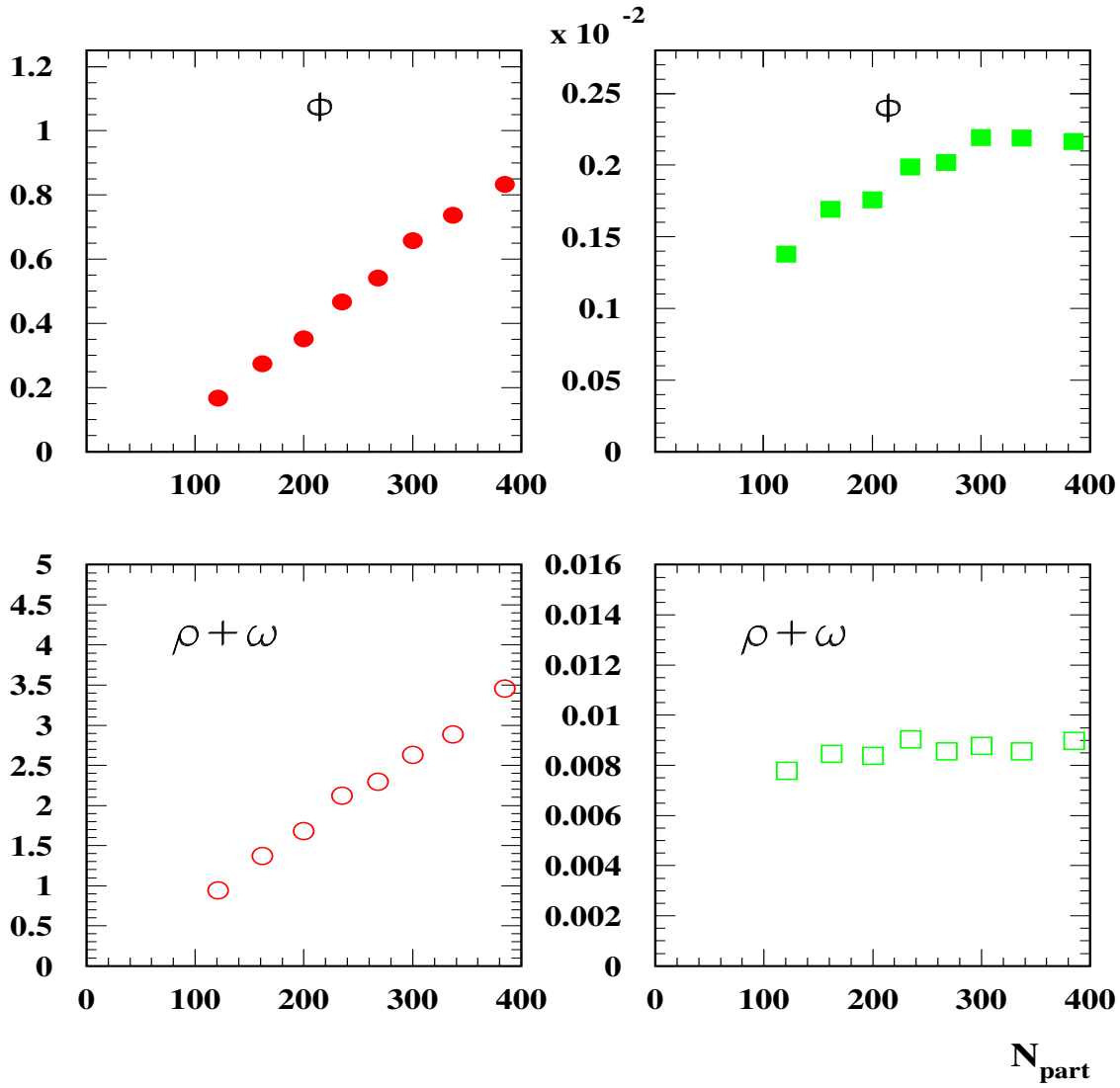
2.8 < Mt < 3.2 GeV/c^2

MULTIPLICITIES / NUMBER OF PARTICIPANTS



MULTIPLICITIES STUDIES

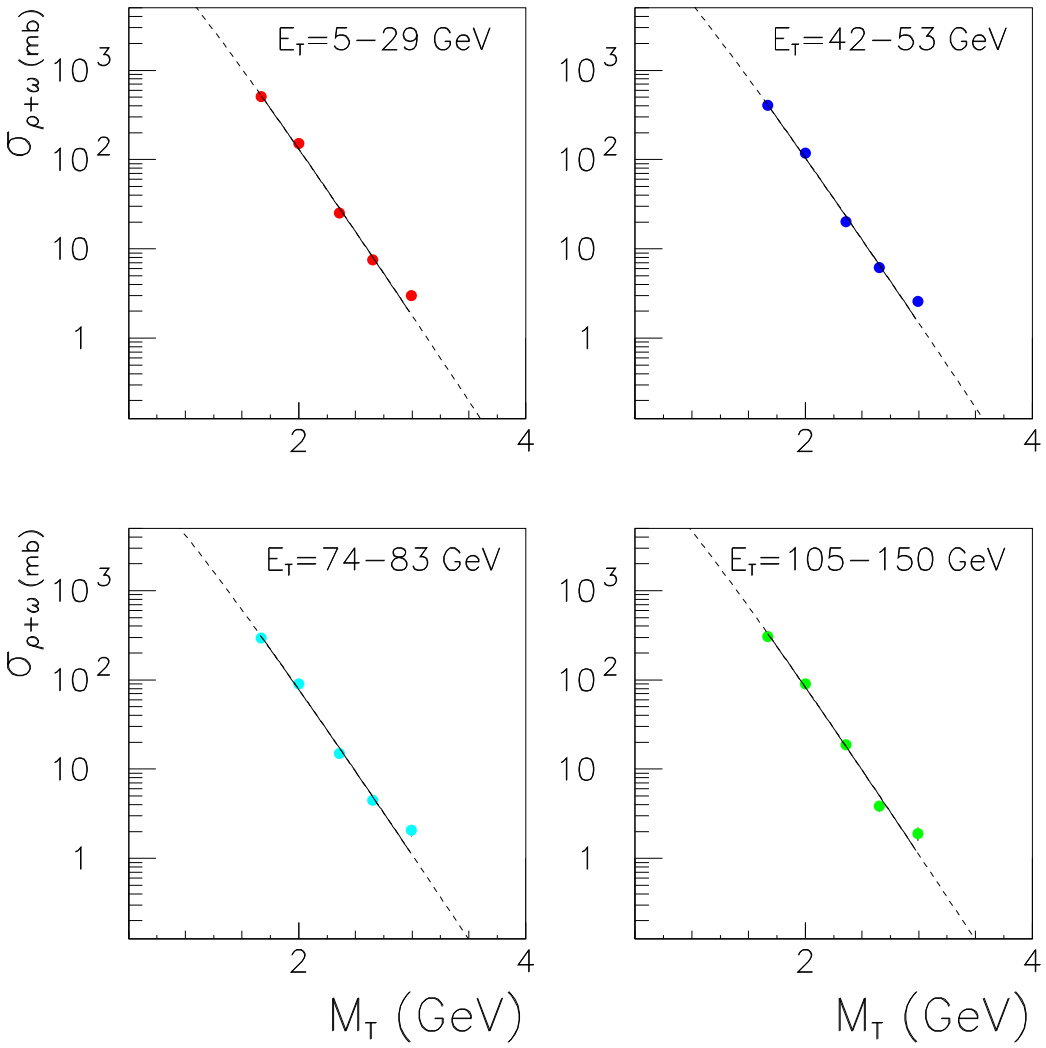
MULTIPLICITIES MULT./ NO.OF PART.



- Flat behaviour of the (ρ+ω) multiplicity /number of participants

- Additionnal Increase of the ϕ multiplicity

CROSS-SECTIONS AND TEMPERATURE



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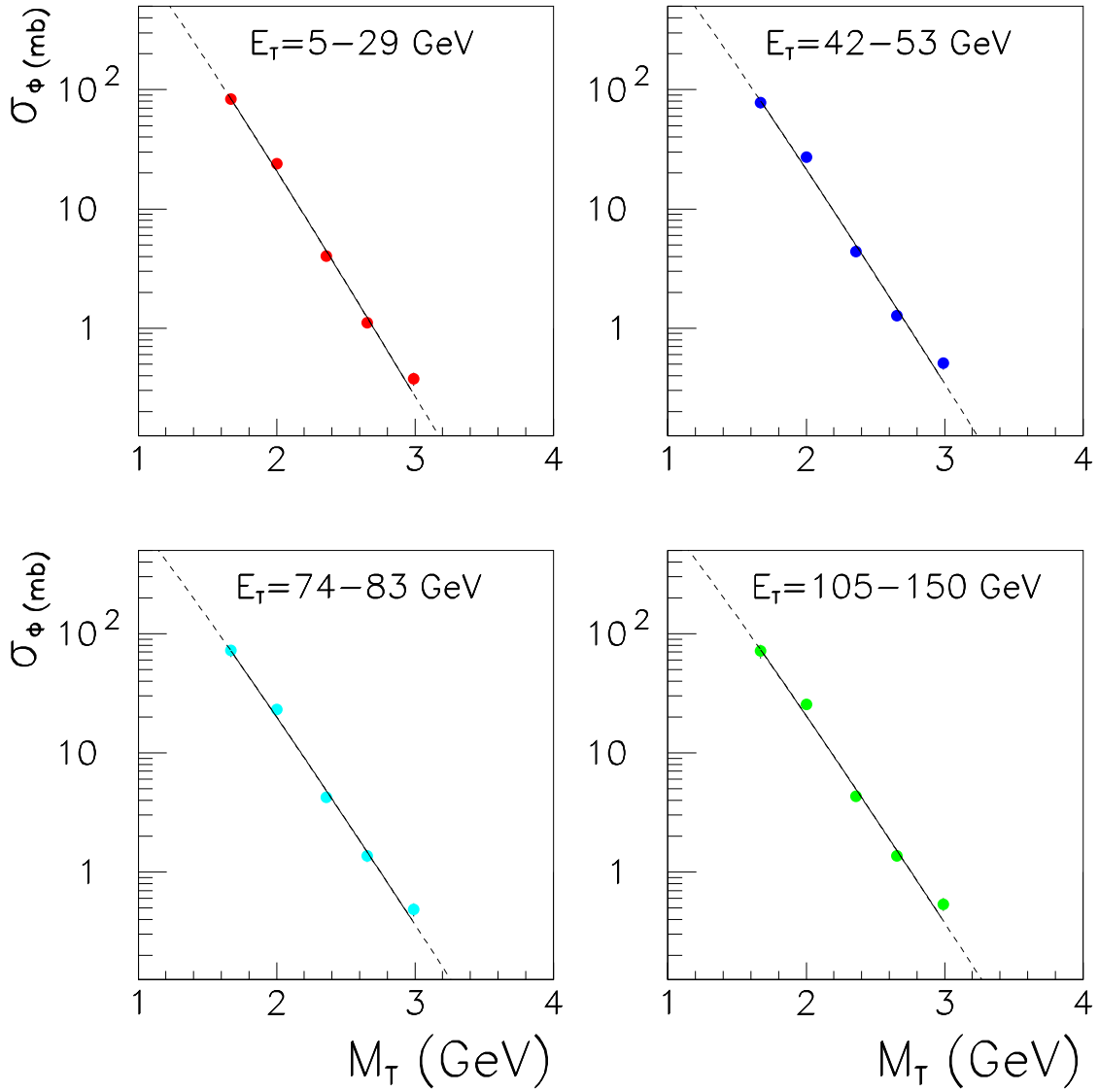
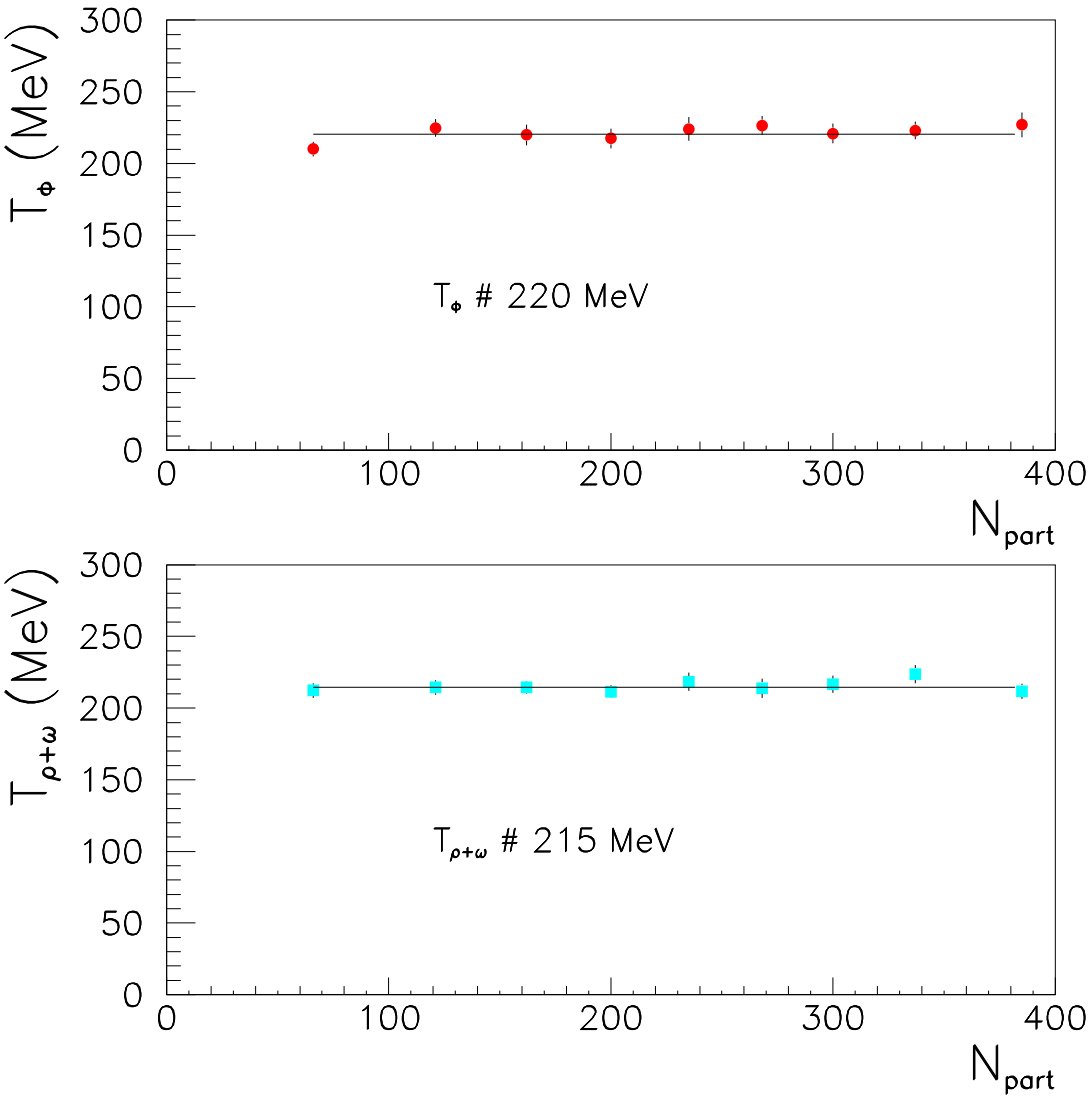


TEMPERATURES for ϕ and ω+ρ



CONCLUSIONS

1) Increase of ϕ/(ω+ρ) with centrality in Pb-Pb system.

2)From multiplicity studies :
Linear behaviour of (ω+ρ) production versus the number of participants whereas a stronger increase versus the number of participants, is observed for the ϕ resonance.

3) Temperature studies :
$T_{\phi} \approx 220$ MeV and $T_{(\omega+\rho)} \approx 215$ MeV