ϕ and $\rho + \omega$ vector-mesons produced in lead induced collisions

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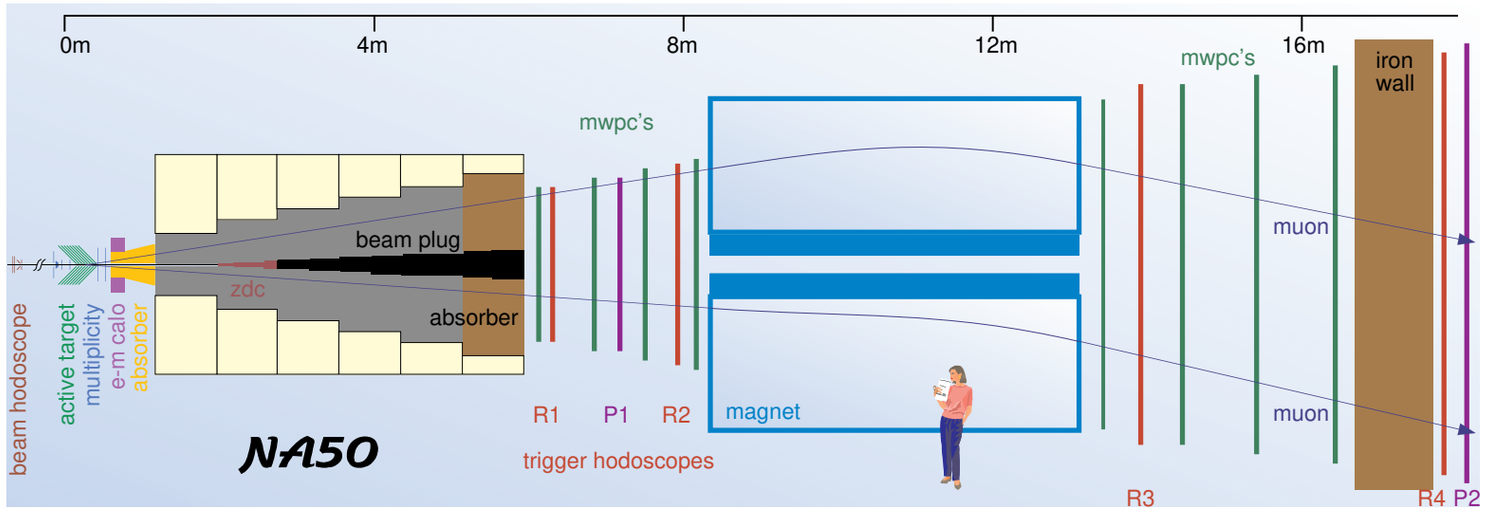
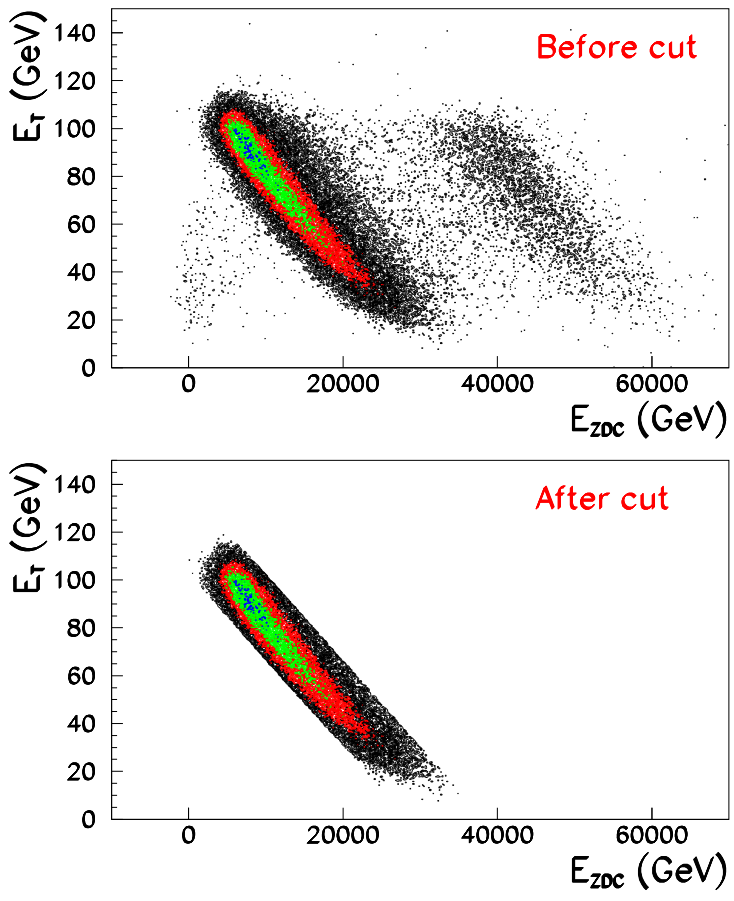


Set-up and Data selection

- Pb+Pb 1998 data: 1 single target 3mm thick
- Require signal from the target's quartz blades to accept event
- Reject tracks whose extrapolation to the target region deviates too much
- Reject events that deviate from the E_T vs E_{ZDC} correlation



Deconvolution method

- To go from the measured variables to the produceded variables we use a deconvolution method.

  $\hookrightarrow$ Data must be corrected for acceptance and smearing effects

$\Downarrow$

Monte Carlo simulation

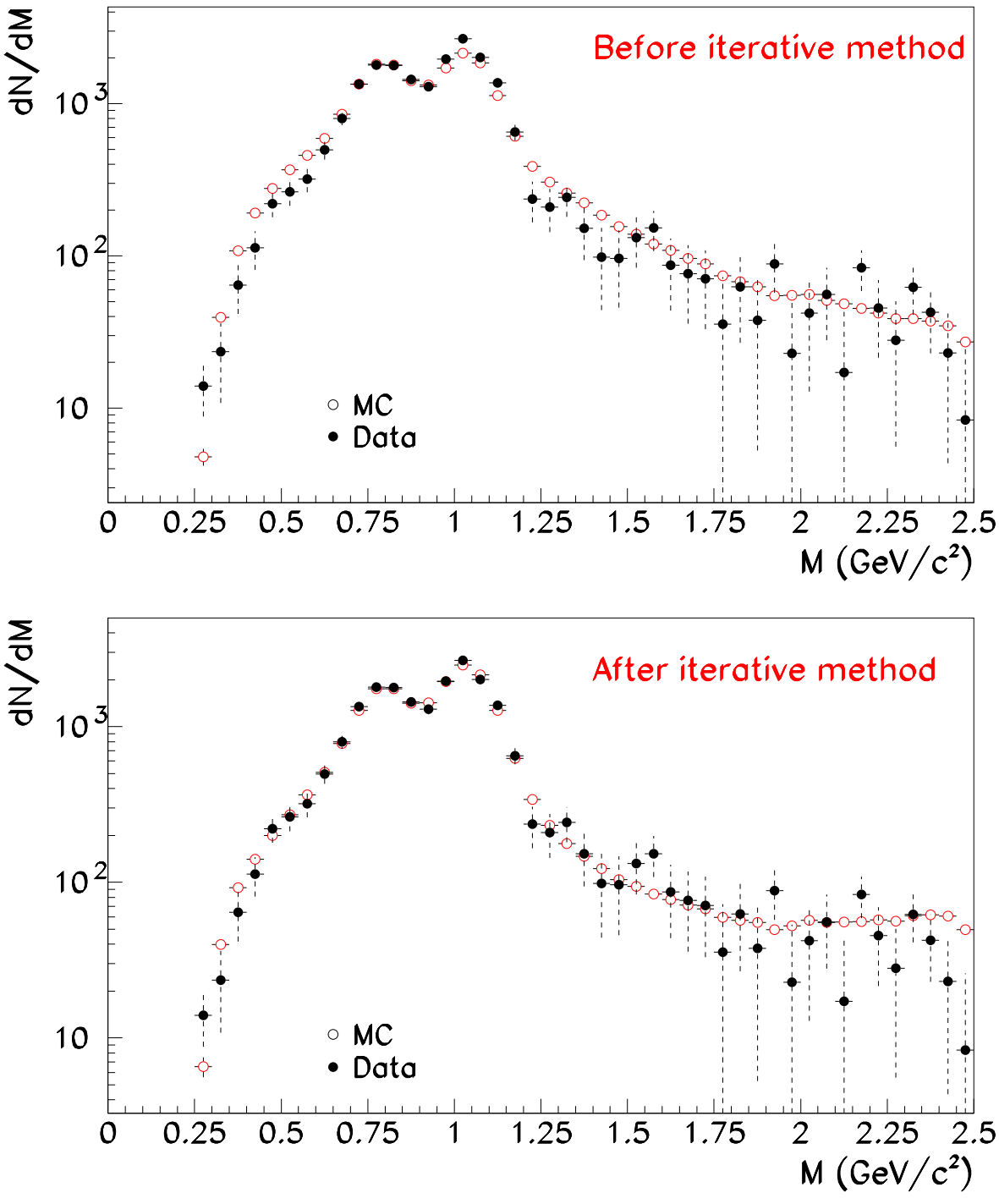
- Mass: ρ, ω and ϕ as classical Breit-Wigners + a continuum parameterized as a decreasing exponential
- P_T: Bessel function with T=236 MeV
- Rapidity: Gaussian with $Y_o = 0$ and $\sigma = 1.25$
- $\cos\theta$: $1 + \cos^2\theta$

$\hookrightarrow$ MC spectra are then adjusted to data using an iterative method, per mass, P_T, rapidity and E_T bins.

Comparison between MC and Data

$53 \leq E_T < 64$ GeV

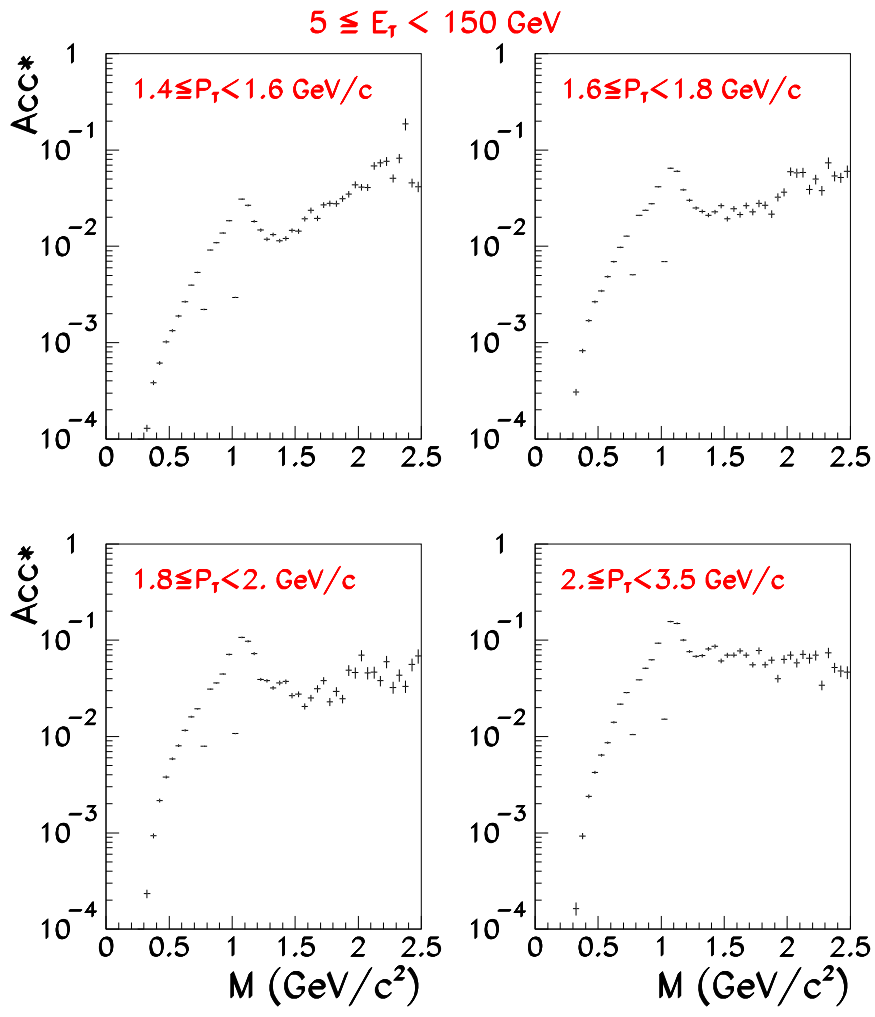
$1.4 \leq P_T < 3.5$ GeV



Acceptance and Smearing

- Acceptance and smearing corrections are calculated from the MC, according to:

$$Accept. \otimes Smearing = \frac{Reconst.\ events|_{meas.\ var.}}{gener.\ events|_{gener.\ var.}}$$

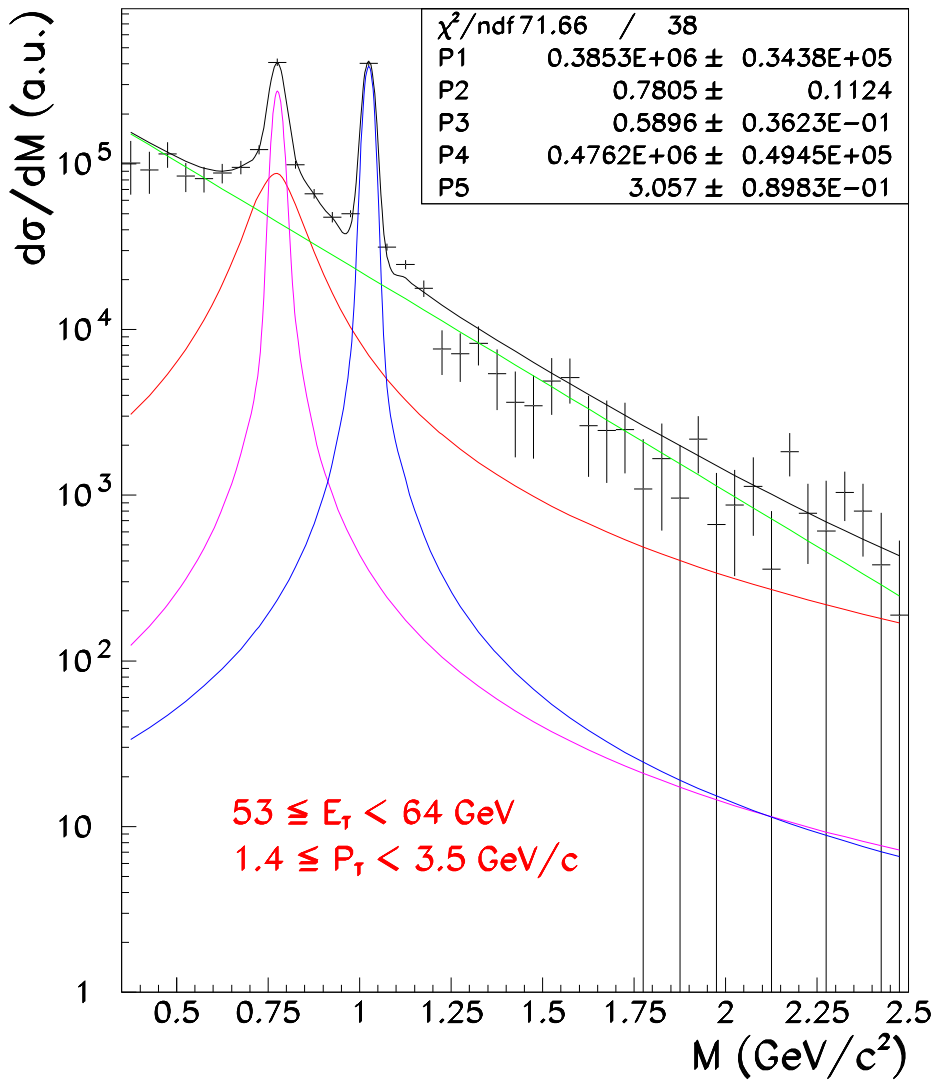


↪ Analysis is done for $P_T \geq 1.4$ GeV/c, in order to have an acceptance in the resonances' mass region $\gtrsim 1\%$.

Strangeness measurement

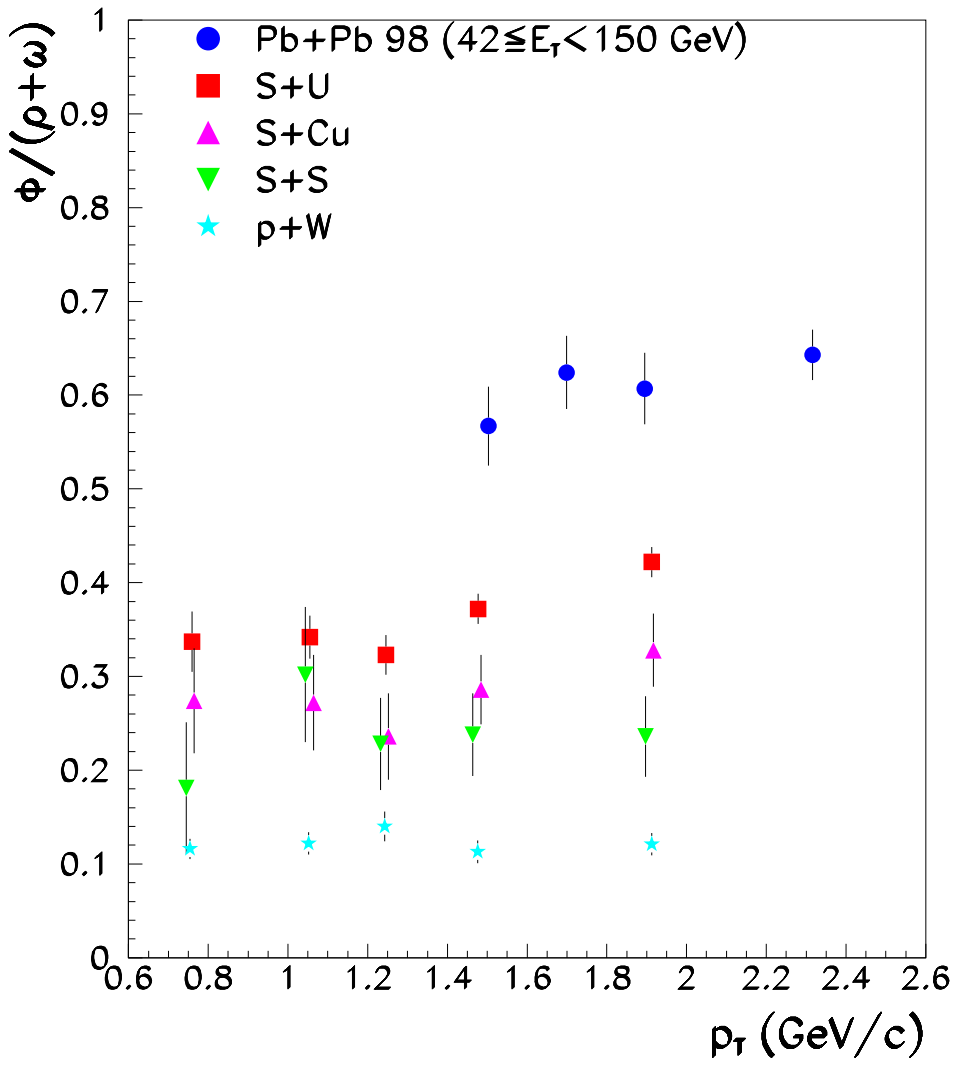
- Mass spectra corrected for acceptance and smearing are fitted with a 5 free parameter function:

$$\mathcal{F} = P_1 BW^{\rho} + P_1 P_2 BW^{\omega} + P_1 P_3 (1 + P_2) BW^{\phi} + P_4 e^{-P_5 M}$$



↪ and extract $\frac{\phi}{\rho+\omega}$: strangeness measurement

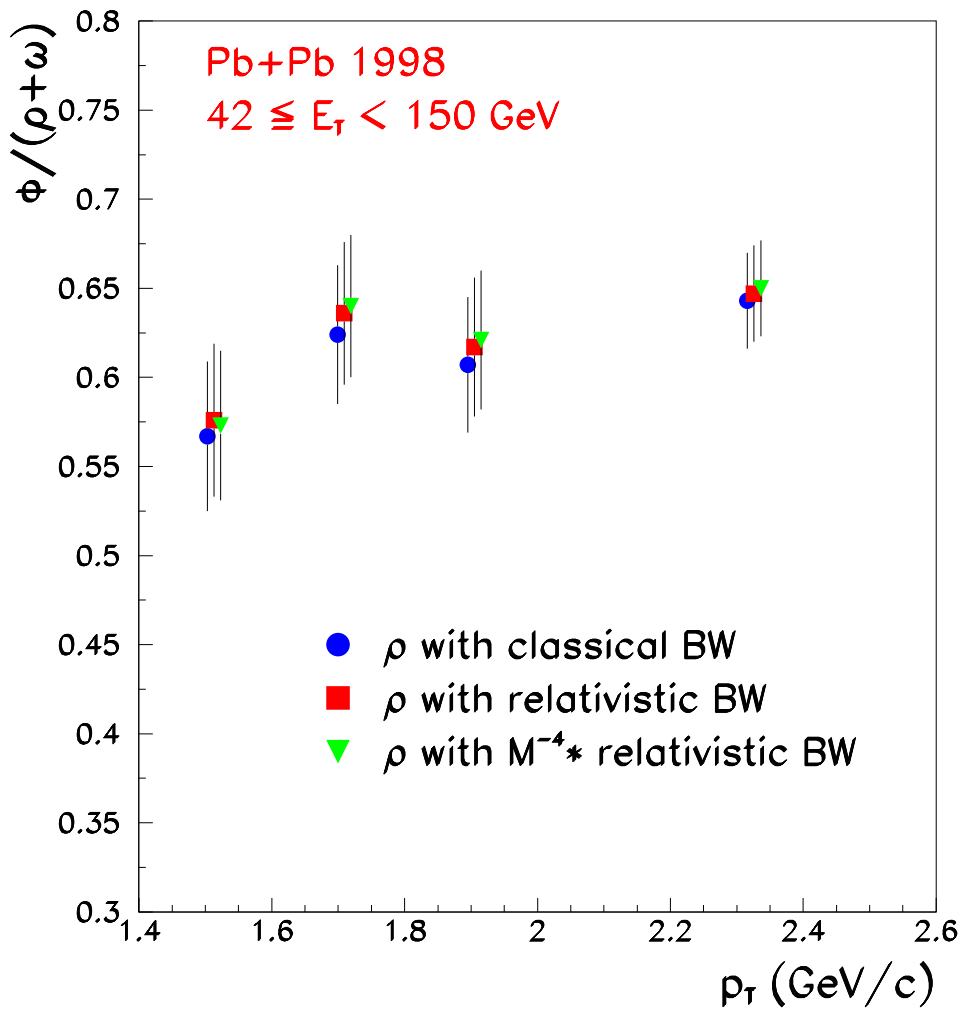
$\frac{\phi}{\rho+\omega}$ as a function of P_T



- $\frac{\phi}{\rho+\omega}$ does not depend on P_T
- The ratio is higher for heavier systems

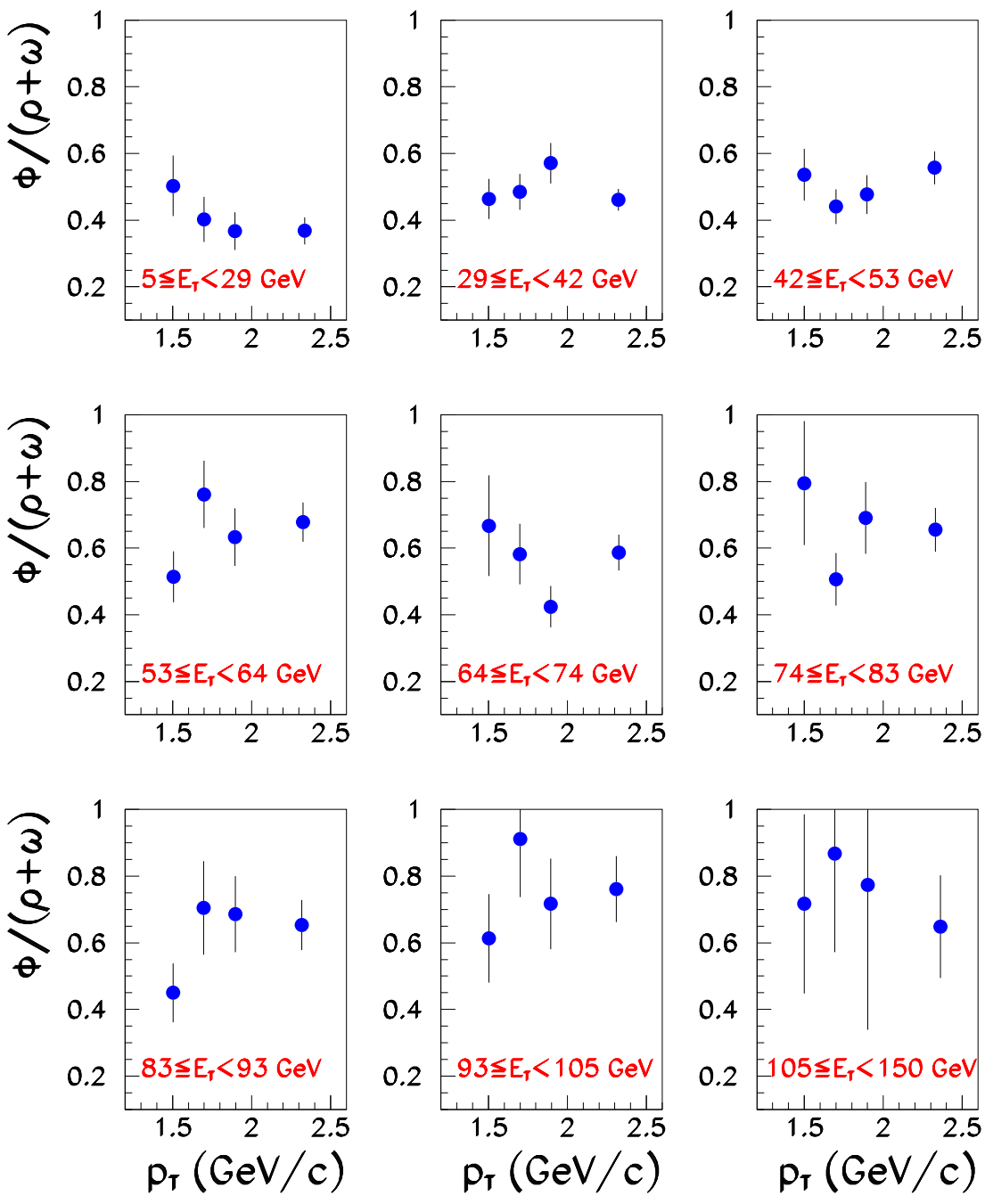
ρ-shape

- 3 different ρ-shapes are studied:



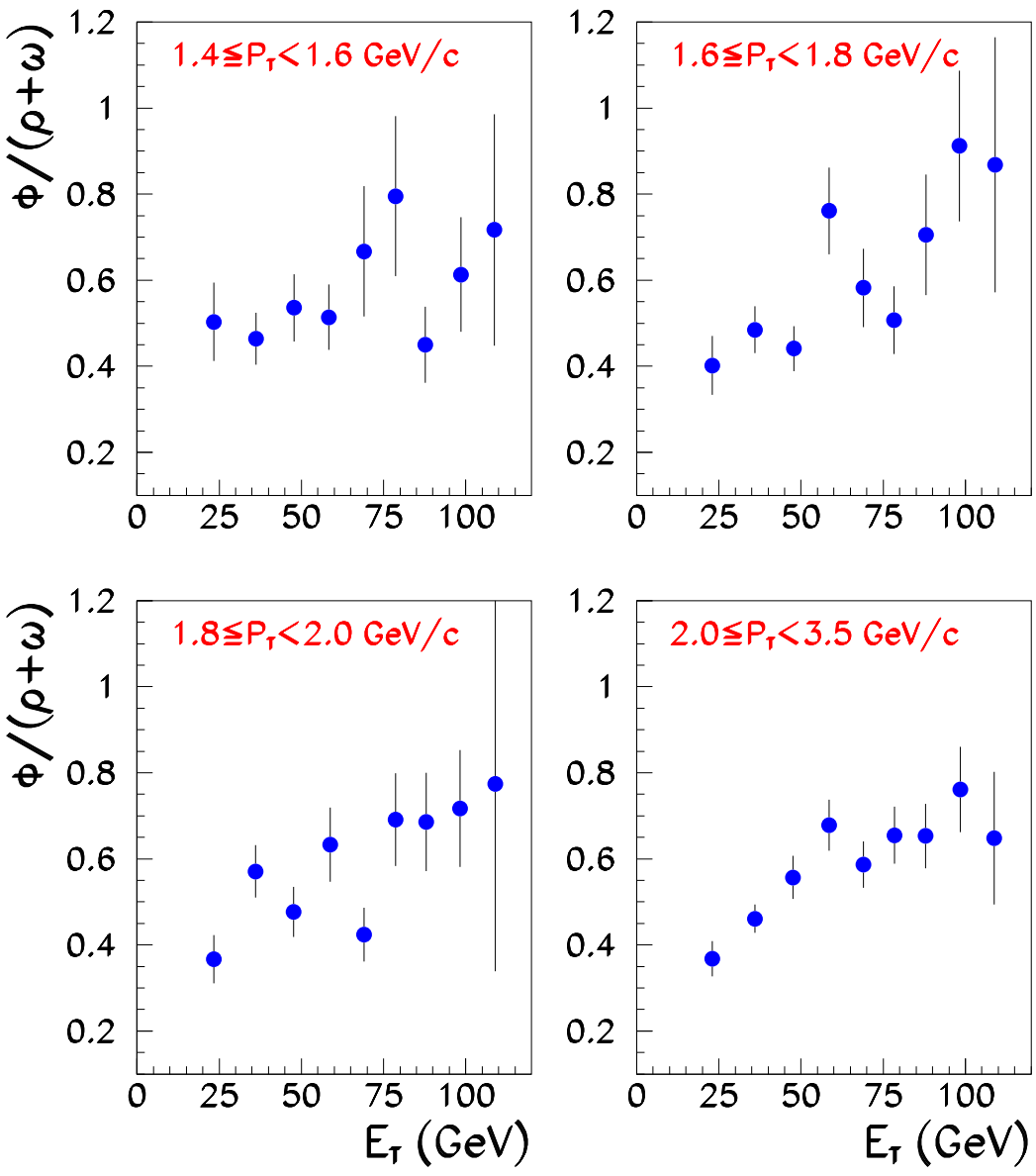
$\hookrightarrow$ The ratio $\frac{\phi}{\rho+\omega}$ does not depend on the form of the ρ fit function, within errors.

$\frac{\phi}{\rho+\omega}$ as a function of P_T for different E_T regions



- No dependence is seen with P_T.

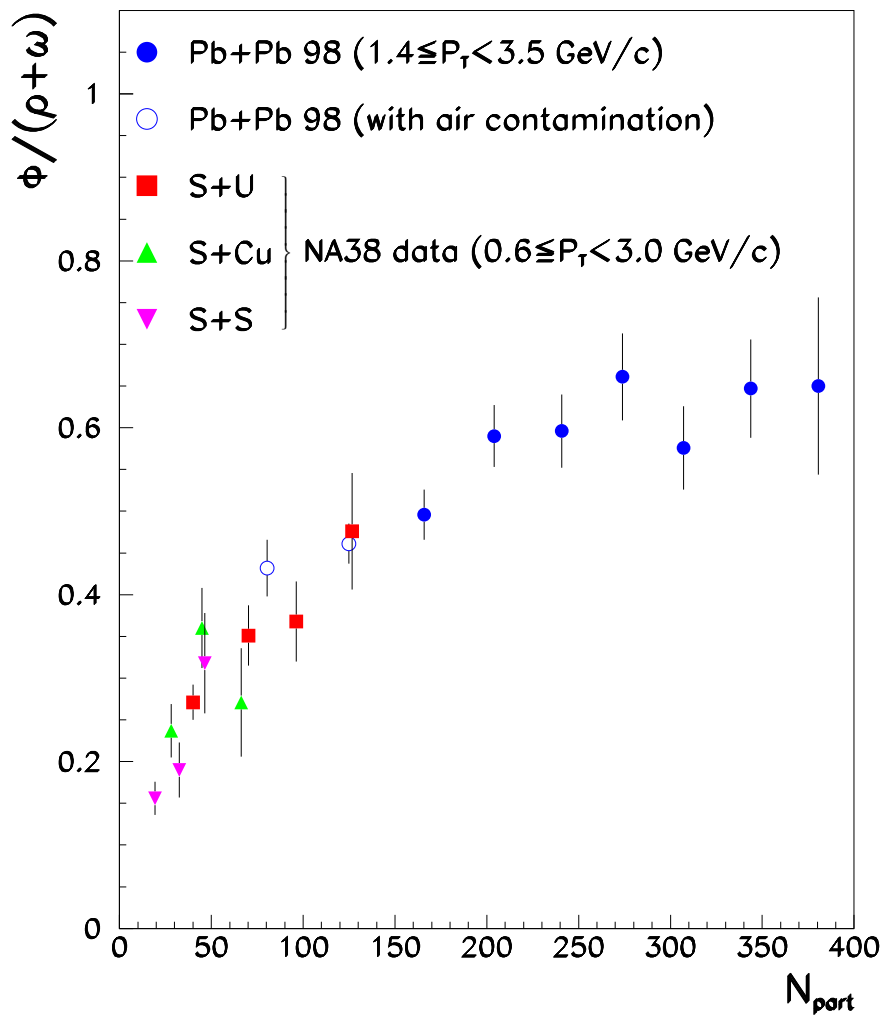
$\frac{\phi}{\rho+\omega}$ as a function of E_T for different P_T regions



- Slight increase with the centrality of the collisions.

$\frac{\phi}{\rho+\omega}$ as a function of N_{part}

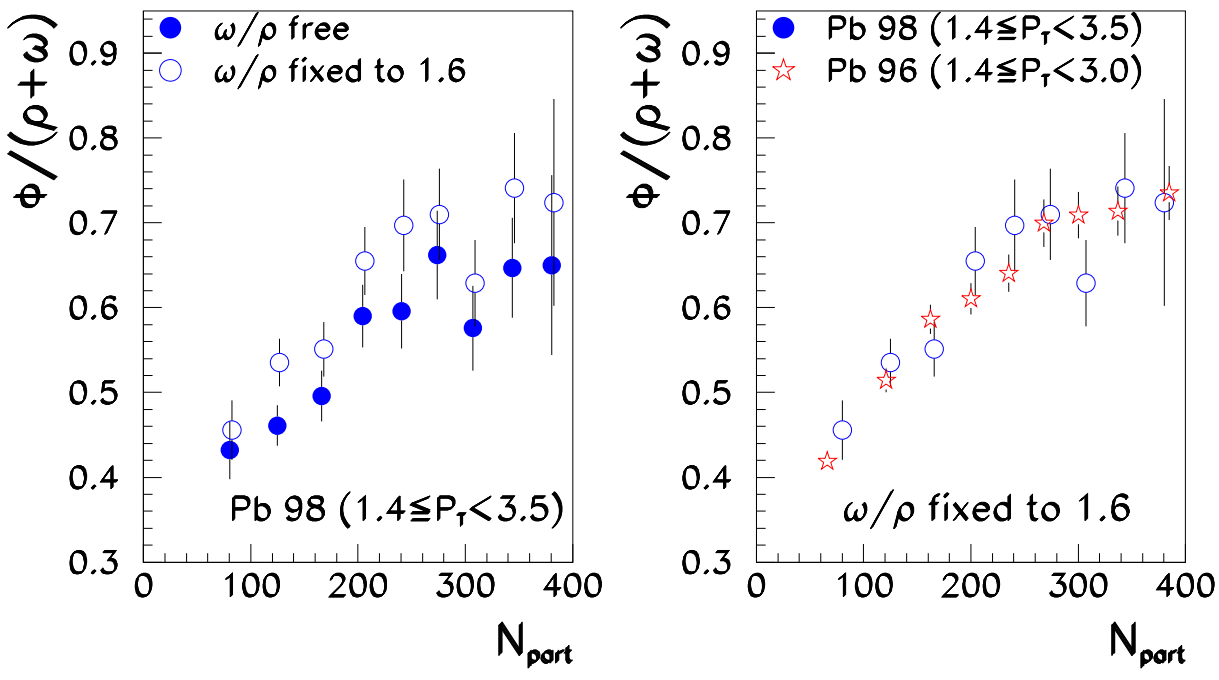
- The number of participant nucleons N_{part} is evaluated with Glauber model in each E_T bin.



↪ Strangeness production increases smoothly with N_{part} (or E_T) and with AB.

Sensitivity to ω/ρ

- If we fix the ω/ρ to 1.6 (the ratio of their branching ratios into muons, as in the PDG), although in agreement within errors, the ratio $\phi/(\rho+\omega)$ is systematically higher than with the fits with ω/ρ free, **but the quality of the fits deteriorates**. When ω/ρ is let free, $\langle\omega/\rho\rangle$ **= 0.76** .



↪ This analysis of 98 Pb+Pb data is in very good agreement with the previous 96 Pb+Pb results.

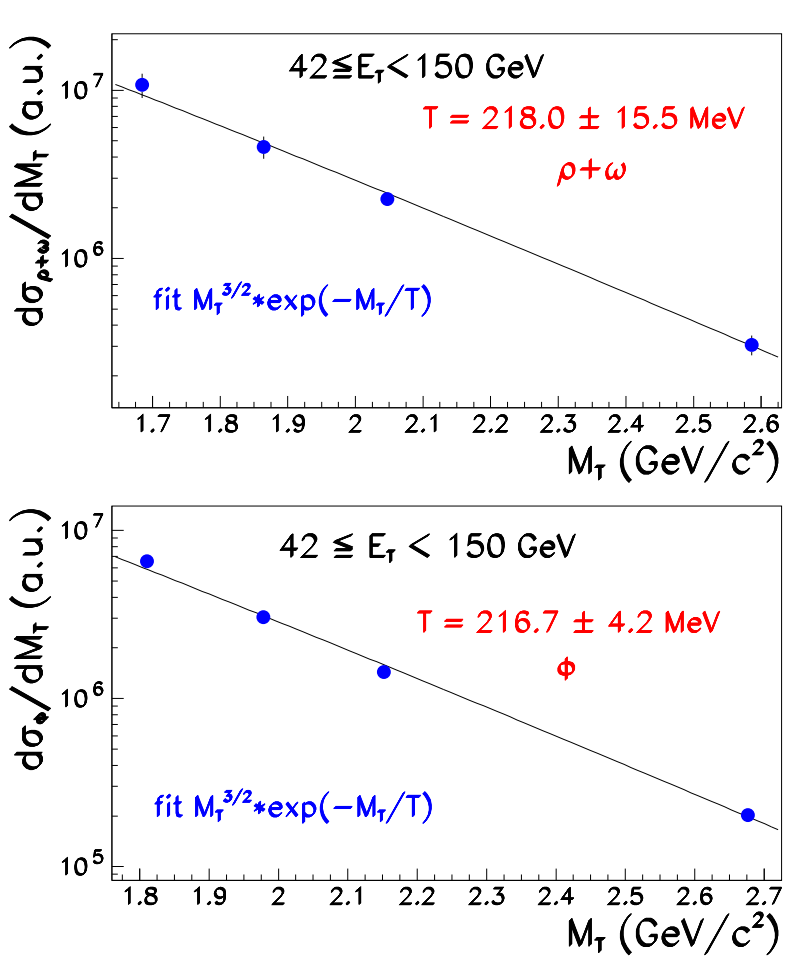
Inverse slopes

- Mass spectra are fitted with a 5 free parameter function:

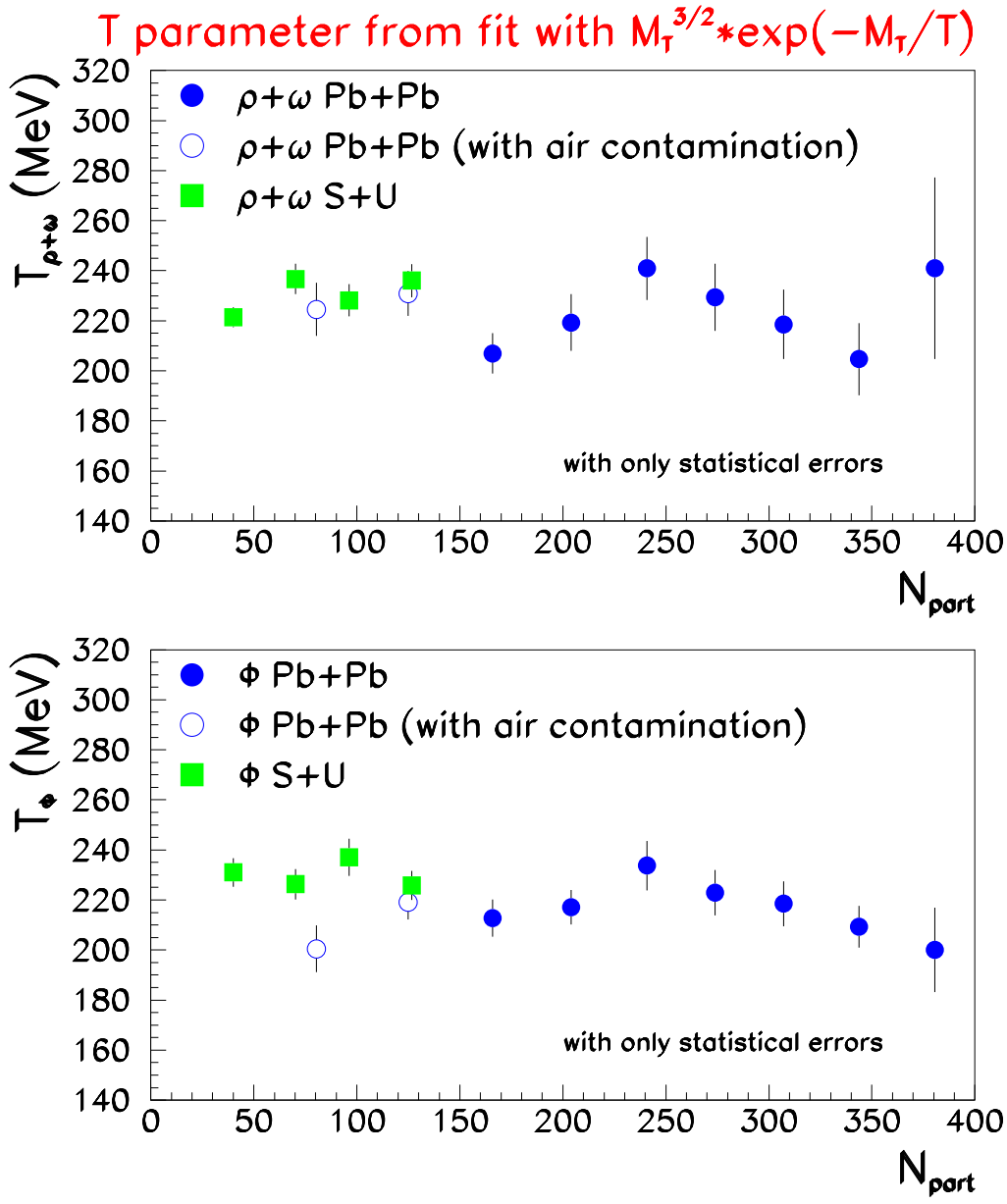
$$\mathcal{F} = P_1 BW^{\rho} + P_2 BW^{\omega} + P_3 BW^{\phi} + P_4 e^{-P_5 M}$$

- The number of $\rho + \omega$ and the number of ϕ are divided by the corresponding M_T bins where they were evaluated.
- Resonances' temperatures are obtained assuming the M_T scaling:

$$\frac{d\sigma}{dM_T} \propto M_T^{3/2}\, exp(-M_T/T)$$



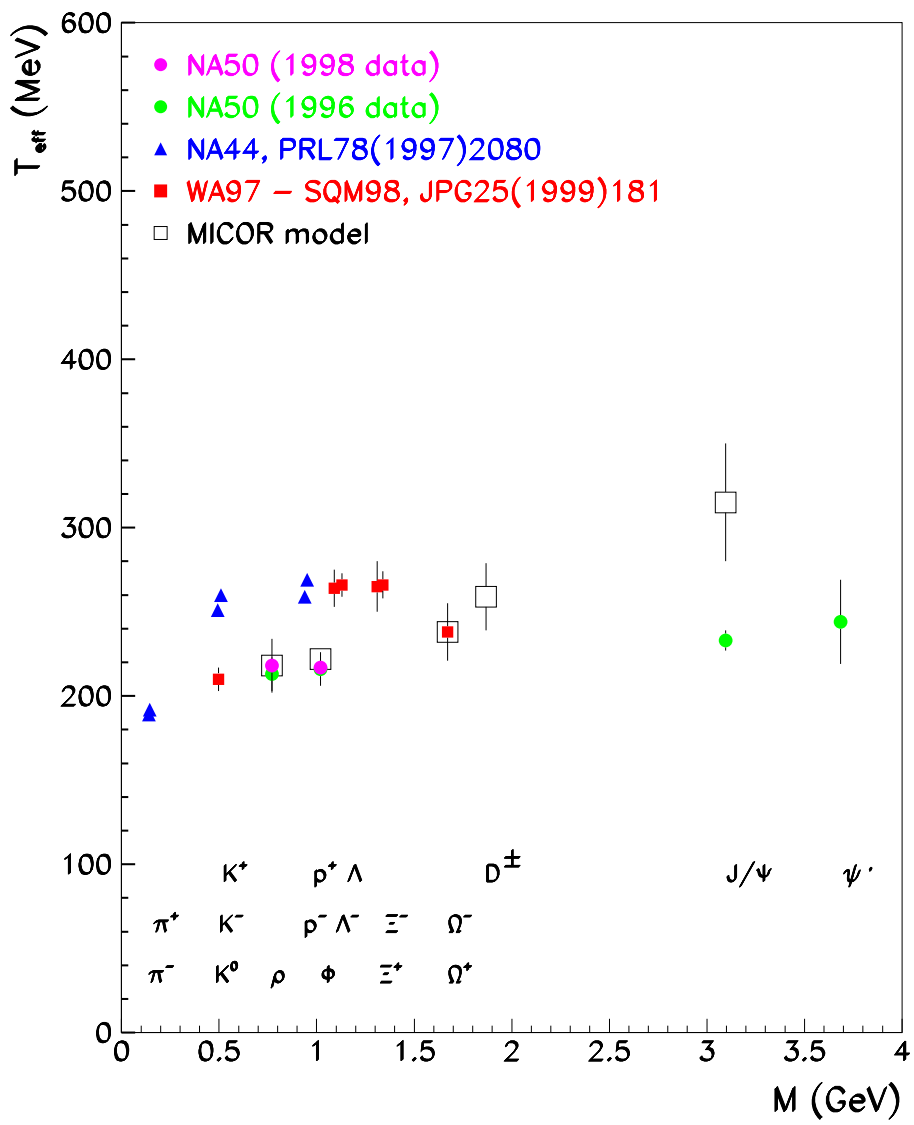
Temperature as a function of N_{part}



- The inverse slope does not depend on the centrality of the collisions.

Temperature as a function of the particle's mass

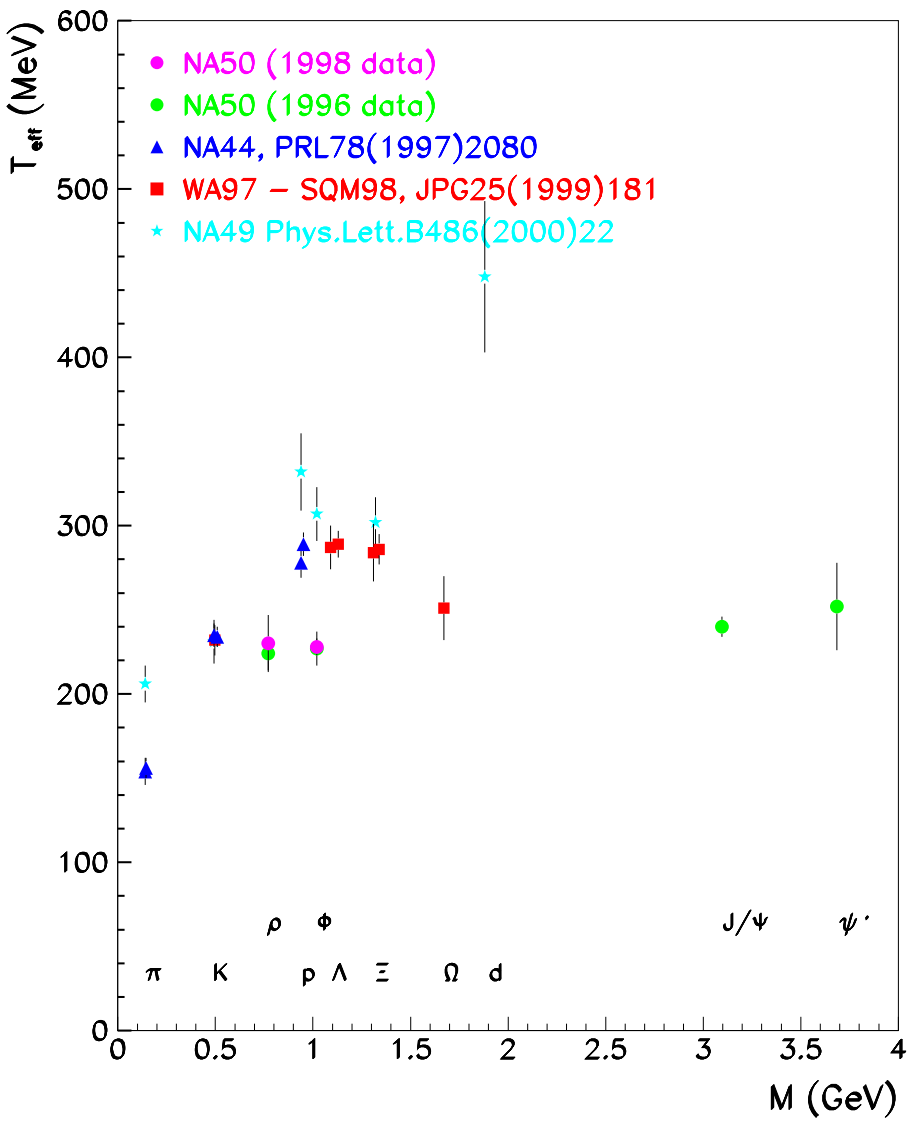
- Using as M_T scaling $M_T^{3/2}\, exp(-M_T/T)$, experiments obtain inverse slopes for the different particles:



↪ NA50 results for $\rho + \omega$ and ϕ are in agreement with theoretical calculations from MICOR model.

Temperature as a function of the particle's mass (2)

- Using the fit function $M_T\ exp(-M_T/T)$ we obtain $T_{\rho+\omega} = 230 \pm 17$ MeV and $T_{\phi} = 228 \pm 5$ MeV.



Summary

- Pb+Pb collisions at 158 A GeV/c, using one single target, are analyzed (1998 data). The low mass region ($0.35 \leq M < 2.5$ GeV/c^2) is studied, using a deconvolution method.
- The ratio $\phi/(\rho + \omega)$ integrated in E_T is studied in 4 P_T regions, showing no dependence with P_T.
- The ratio $\phi/(\rho + \omega)$ integrated in $1.4 \leq P_T < 3.5$ GeV/c shows a slight increase with the centrality of the collisions (E_T and N_{part}).
- When comparing sulphur induced collisions (NA38 data) with Pb+Pb, the ratio $\phi/(\rho + \omega)$ increases when going from lighter to heavier systems and saturates for lead.
- Temperatures obtained for $\rho + \omega$ and for ϕ are $\approx$ 220 – 230 MeV.