Production of ϕ -meson in p+p, p+Pb and central Pb+Pb collision at $E_{beam} = 158\ AGeV$

NA49 collaboration

Abstruct

p+p, p+Pb, Pb+Pb衝突からのϕ-messonのYieldsや空間分布が報告されました。 $\phi \rightarrow K^{+}K^{-}$ の崩壊をつかってIDしました。この割合に関して重要な増加が、p+pやp+Pbでも観測された。ϕのピークの移動や幅の広がりは見られなかった。

Experiment

・4つのTPC、2つのカロリメータ
TOFからなる。（NA49）
・TPCのdE/dxと
TOF(Kaon)でPIDする
・Pb+Pb → 380000
p+p → 400000
p+Pb → 180000イベントを解析した。

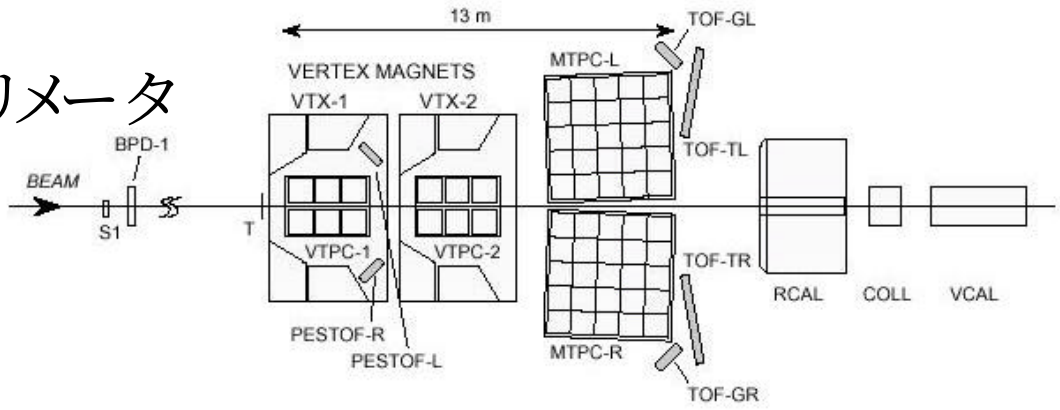

Figure 1. The NA49 large acceptance hadron detector

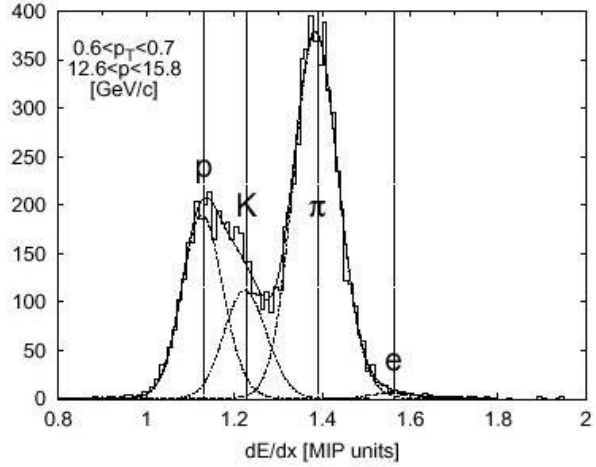

Figure 5. Distribution of the specific energy loss in the indicated $(p,\ p_T)$ bin in central Pb+Pb reactions for positive particles. The solid lines indicate the result of the fit.

Result

・φの位置

p+p → 1019.4±0.2

p+Pb →1019.0±0.3

Pb+Pb →1018.7±0.5

・σ_m

p+p → 1.1±0.2

Pb+Pb →1.6±0.3

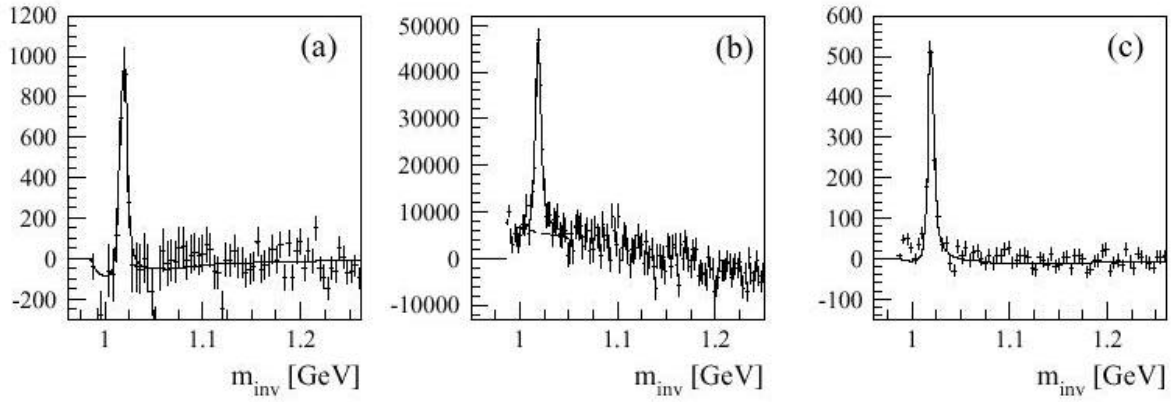

Fig. 1. Representative ϕ-signals in K^+K^- invariant-mass spectra after background subtraction. a: Pb+Pb at midrapidity, TOF+dE/dx identification; b: Pb+Pb, MTPC acceptance, dE/dx; c: p+p, full acceptance, dE/dx.

・$dn/(m_t\, dm_t) \alpha \exp(-m_t/T)$

T = 305±15MeV(Pb+Pb)

＝169±17MeV(p+p)

・σ_y 1.22±0.16(Pb+Pb)

σ_y 0.89±0.06(p+p)

$\langle\phi\rangle$ 7.6±1.1 (Pb+Pb)

$\langle\phi\rangle$ 0.012±0.0015(p+p)

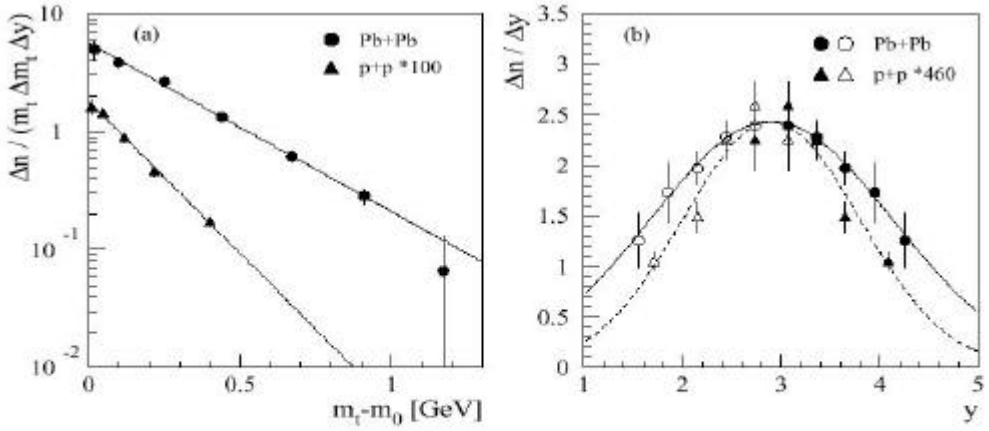

Fig. 2. a) Transverse-mass distributions of ϕ-mesons (averaged over rapidity) for Pb+Pb ($3.0 < y < 3.8$) and p+p ($2.9 < y < 4.4$). b) Rapidity distributions of ϕ-mesons for Pb+Pb and p+p. Full symbols represent measured points, open ones are reflected at midrapidity (y__ = 2.9).

Result 2

・p+pのデータは他の実験と consistent

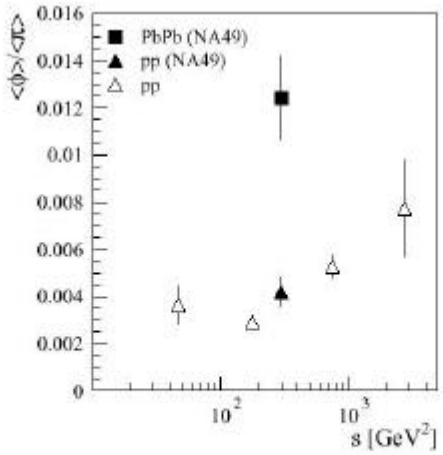

Fig. 3. ϕ/π ratio measured for Pb+Pb in comparison with p+p data (NA49 and previous work [18]) as a function of the square of the center-of-mass energy per nucleon pair. π yields in p+p were taken from [21].

・$\langle\phi\rangle/\langle\pi\rangle$のmultiplicity dependence

$(\langle\phi\rangle/\langle\pi\rangle)_{p+Pb}/(\langle\phi\rangle/\langle\pi\rangle)_{p+p}$ のcentrality dependence

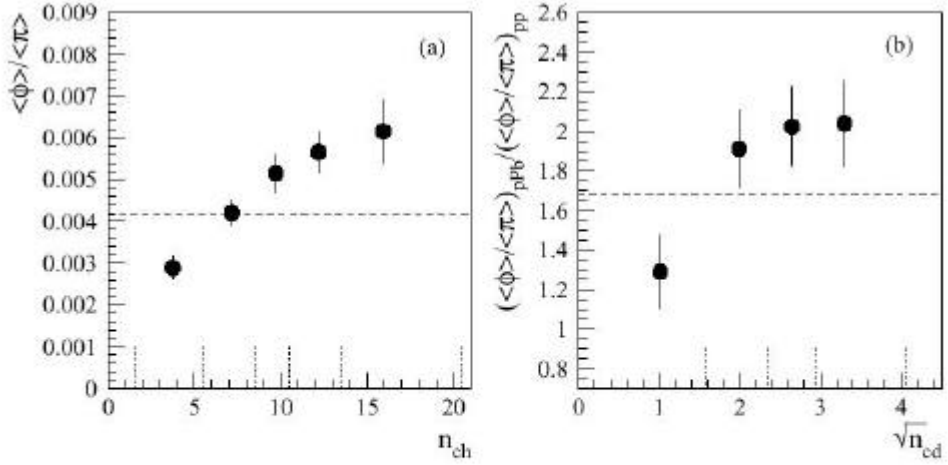

Fig. 4. a) Multiplicity dependence of the ϕ/π ratio in p+p. The cross-section weighted average is indicated by the horizontal dashed line. b) Centrality dependence of the ϕ/π ratio in the forward hemisphere in p+Pb normalized to the average p+p value. The minimum-bias value is indicated by the horizontal dashed line. Vertical dashed lines indicate bin sizes in the abscissa.

Discussion

φ enhancement factor

$$\frac{\langle\phi\rangle/\langle\pi\rangle(Pb+Pb(central))}{\langle\phi\rangle/\langle\pi\rangle(p+p(inelastic))}=3.0\pm0.7$$

Hadro-chemical modelが適用できる →
Thermo-dynamical modelで予想される値は測定値より1.6倍大きい。

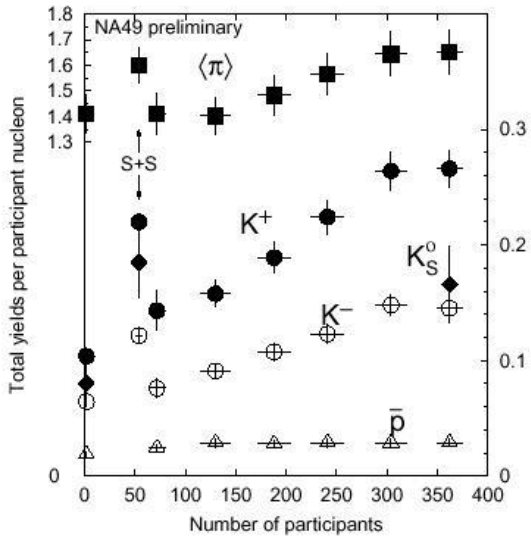

Figure 10. Dependence of the total yields per participant nucleon on the number of participants in p+p and Pb+Pb collisions in six centrality bins. Values for average charged pions, charged kaons, K^0_S and antiprotons are shown with the results on S+S from NA35 [8]. The vertical scale on the left side belongs to the pions, the right one to the kaons and antiprotons.

・$\langle\phi\rangle/\langle\pi\rangle$ はpp vs pPbで1.7倍増えている。
→ 衝突回数が増えるとφの生成量が増える

Summary

- $\langle\phi\rangle/\langle\pi\rangle$ のenhance factor は 3.0±0.7 (pp vs Pb)
- φのmassやwidthは変化なし。
- pp vs pPbを比べると$\langle\phi\rangle/\langle\pi\rangle$ の割合が増加。
- $\langle\phi\rangle/\langle\pi\rangle$ の増加量はパートン相を仮定したモデルとあっている。