MESON PRODUCTION IN p+U, O+U AND S+U INTERACTIONS AT 200 GeV/NUCLEON

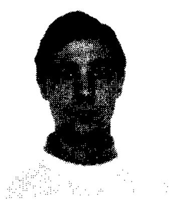
NA38 Collaboration

M.C. Abreu[5], M. Alimi[6], C. Baglin[1], A. Baldisseri[1], A. Baldit[3], M. Bedjidian[6], P. Bordalo[5], A. Bussière[1], P. Busson[4], R. Cases[9], J. Castor[3], T. Chambon[3], C. Charlot[4], B. Chaurand[4], D. Contardo[6], E. Descroix[6], A. Devaux[3], O. Drapier[6], J. Fargeix[3], X. Felgeyrolles[3], R. Ferreira[5], P. Force[3], L. Fredj[3], J.M. Gago[5], C. Gershel[7], P. Gorodetzky[8], B. Grosdidier[8], J.Y. Grossiord[6], A. Guichard[6], J.P. Guillaud[1], R. Haroutunian[6], D. Jouan[7], L. Kluberg[4], R. Kossakowski[1], G. Landaud[3], P. Liaud[1], C. Lourenço[5], S. Papillon[7], L. Peralta[5], J.R. Pizzi[6], C. Racca[8], S. Ramos[5], A. Romana[4], R.A. Salmeron[4], P. Sonderegger[2], F. Staley[1], S. Silva[5], X. Tarrago[7], J. Varela[5], F. Vazeille[3]

(1)-Annecy, (2)-CERN, (3)-Clermont-Ferrand, (4)-Ecole Polytechnique, (5)-Lisbon, (6)-Lyon, (7)-Orsay, (8)-Strasbourg, (9)-Valencia

Presented by Luis Peralta

LIP - Av. Elias Garcia 14 - 1, P-1000 Lisboa, Portugal



Abstract

Meson production in proton, oxygen and sulphur interactions with uranium targets at 200 GeV/nucleon is studied, using like-sign decay muons. We measure the inclusive positive and negative meson cross sections $d\sigma/dP_T^2$ and study their evolution with the projectile mass assuming a $A_{proj}^{\alpha(P_T)}$ dependence. Unlike negative mesons, the $\alpha(P_T)$ parameter shows no P_T dependence for positive mesons in the range 0.4 to 3.0 GeV/c. Cross sections fitted to an exponential, give an inverse slope P_{T0} of the order of 210 MeV/c. As a function of the neutral transverse energy, P_{T0} values show a sligth rise followed by a plateau. The difference between positive and negative kaons is studied as a function of transverse energy, in O+U and S+U collisions.

An important fraction of the NA38 data arises from uncorrelated π and K decays which generate both opposite-sign and like-sign muon pairs. This like-sign muon pair sample can be unambiguously traced back to π and K decays. A strong correlation in P_T exists between the parent meson and its decay muon [1]. Therefore, it is possible to extract meson distributions from the measured muon ones. Morever, like-sign muon pairs are almost background free, as the contribution from correlated decays is found to be less than 1% .

The muon pairs are measured in the NA10 spectrometer [2], optimized to detect low mass dimuons. An electromagnetic calorimeter [3] provides a measurement of the transverse neutral energy E_T released in the interaction ($1.9 < \eta_{lab} < 4.1$). A more complete description of the experimental setup can be found elsewhere [4,5].

As only decay muons are measured, the meson production cross section must be computed in two steps: in first place a muon yield is extracted and afterwards the meson cross section is calculated using a Monte Carlo simulation based on the Fritiof Lund generator [6]. In this way, we study inclusive meson production in proton, oxygen and sulphur interactions and compare them to previous pN results.

Table 1: P_{T0} values (in MeV/c) from a fit in the range $0.7 \leq P_T \leq 1.4$ GeV/c

Charge	$p+U$	$O+U$	$S+U$
+	209± 3	213±2	211±2
−	199± 3	203±2	211±2

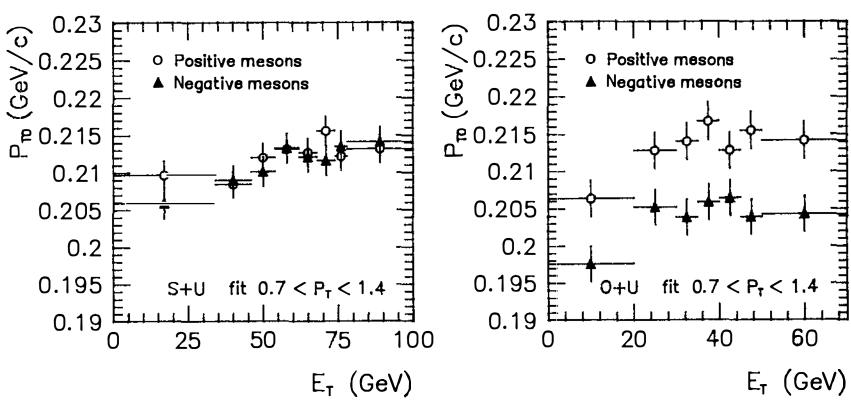


Figure 1: Inverse slope P_{T0} as a function of E_T for positive and negative mesons in S+U and O+U collisions

A fit to the differential cross section using the parametrization

$$\frac{d\sigma}{dP_T^2} \propto exp\left(-\frac{P_T}{P_{T0}}\right)$$

is performed in the range 0.7 to 1.4 GeV/c. P_{T0} values range from 199 to 213 MeV/c (see table 1) and are close to some QCD predictions on the lattice for the transition temperature between hadron and plasma phases [7,8]. A small rise in P_{T0} with the projectile mass is also measured. Positive particle P_{T0} values are systematically above the negative particle ones. This could be attributed to kaons having a higher P_{T0} as compared to pions, as well as the fact that $K^+/\pi^+ > K^-/\pi^-$ [9].

The same analysis can be performed in different E_T regions. Figure 1 shows the behaviour of P_{T0} as a function of the transverse energy E_T, for S+U and O+U systems, and for both charges. A slight increase with E_T, followed by a plateau is seen. The same picture has already been reported by other heavy ion experiments [10,11].

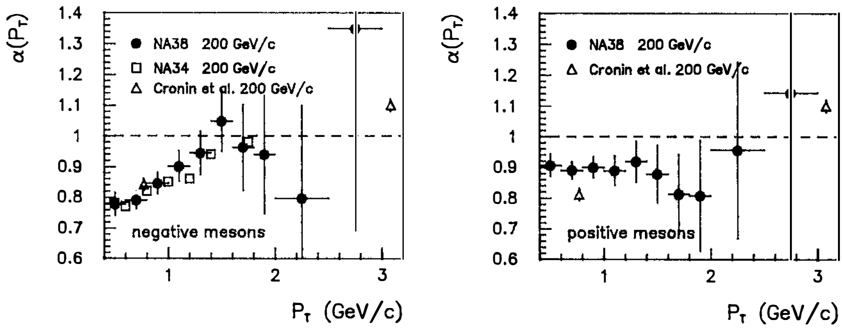


Figure 2: The $\alpha(P_T)$ parameter for negative and positive mesons, measured in S+U and O+U interactions

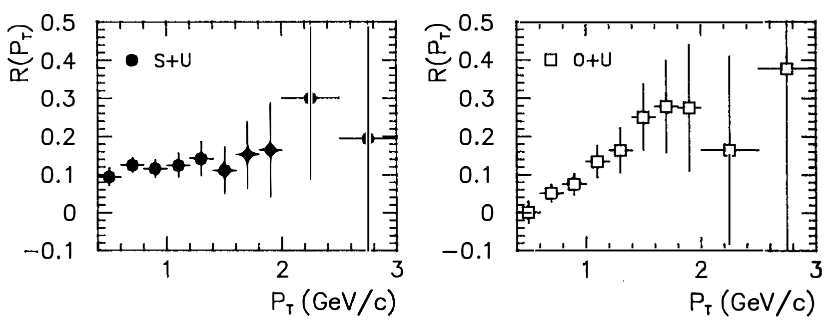


Figure 3: The ratio $R(P_T)$ for S+U and O+U collisions

We study the evolution of the differential production cross section with the projectile mass A assuming a power law dependence $\left(d\sigma/dP_T^2\right)_{AB} \propto A^{\alpha(P_T)}$. The variation of α as a function of P_T taking into consideration only the ion data (O+U and S+U interactions) is shown in fig. 2. For negative mesons $\alpha(P_T)$ increases with P_T (Cronin effect [12]). The measured values are compatible with the ones obtained by other experiments [11,12]. For positive mesons $\alpha(P_T)$ shows no P_T dependence in the measured range.

Information on K production can be extracted from the normalized difference between positive and negative meson cross sections $(\sigma^+ - \sigma^-)/\sigma^-$. Assuming that, for O+U and S+U interactions, π^+ and π^- production rates are equal in the central rapidity region, we have:

$$R = \frac{\sigma^+ - \sigma^-}{\sigma^-} \equiv \frac{(\pi^+ + K^+) - (\pi^- + K^-)}{(\pi^- + K^-)} \approx \frac{K^+ - K^-}{\pi^- + K^-} .$$

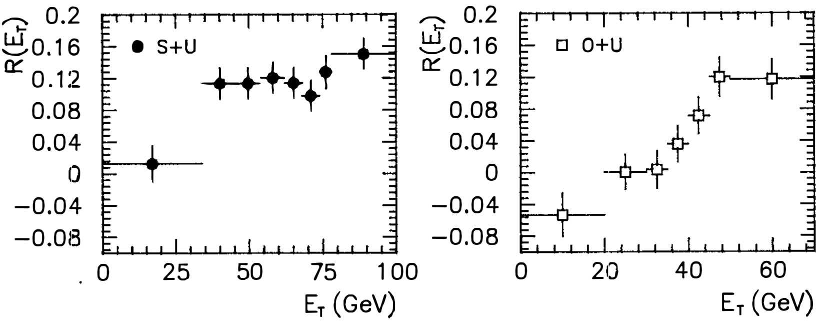


Figure 4: The ratio $R(E_T)$ for S+U and O+U collisions

The ratio R as a function of P_T is showed in fig. 3 for S+U and O+U collisions. A rise with P_T is observed for both systems. This shows an increase in the K^+/π production in comparison to K^-/π production with P_T. The ratio R can also be computed as a function of E_T for $P_T \geq 0.4$ GeV/c. For both S+U and O+U collisions (fig. 4) a clear increase of R with E_T is observed.

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