Kaon and phi production in pion-nucleus reactions at 1.7 GeV/c*

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The production and properties of open and hidden strange mesons (K^+, K^-, ϕ) in cold nuclear matter generated in pion-nucleus reactions ($\pi^- + A, A = C, W$) at $p_{\pi^-} = 1.7$ GeV/c have been studied with the HADES setup (SIS18/GSI).
Of particular interest is the modification of the (anti-)kaon spectral function in nuclear matter which should be already apparent at saturation density [1]. While, for the kaon (K^+, K^0) the repulsive KN-potential has been investigated to some extent having a moderate strength ($20-40$ MeV) [2, 3], the existing data on in-medium effects of the antikaon produced off nuclear targets are very scare [4]. Moreover, the situation of the antikaon is more involved, since the K^- can be absorbed in nuclear matter which should be driven by strangeness exchange processes on one ($K^-N \to Y\pi$) or more nucleons ($K^-NN \to YN\pi$). On contrary, K^+ does not undergo strong absorption processes and can be treated as a quasi particle within nuclear matter, providing stringent constraints on the production mechanism of strange hadrons. In this context, also the ϕ production and absorption ($\phi \to K^+K^-, BR \sim 48.9\%$) off light and heavy nuclear targets is studied.

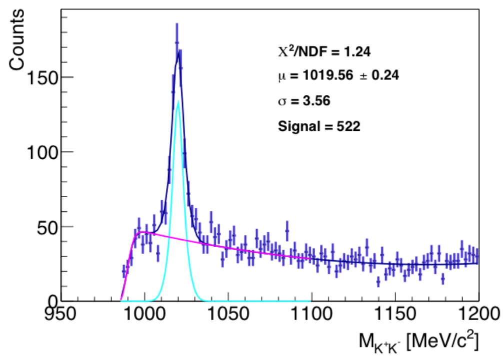

Figure 1: Invariant mass distribution of charged kaons in $\pi^- + C$ reactions. The fit consists of two Gaussian for the ϕ signal together with the background described by a polynomial and Gaussian functions

Both charged kaons are identified by means of time-of-flight (START/RPC/TOF) and momentum measurements as well as by the specific energy loss information in the drift chambers to enhance the signal to background ratio. The neutral ϕ is reconstructed employing the invariant mass of charged kaons ($M_{K^+K^-}$) (Fig. 1), which have been selected within a distinct velocity β range. In total about 4×10^5 K^+, 2×10^4 K^- and 500 ϕ ($\pi^- + C$) and 2×10^5 K^+, 1×10^4 K^- and 300 ϕ ($\pi^- + W$) were reconstructed, respectively.

Evidence on the K^- absorption is obtained on the basis of K^-/K^+ ratios in both nuclear environments (C, W) as a function of four different kinematic observables (p, θ, p_T, y). Figure 2 shows the ratios as a function of momentum. Furthermore they are compared the expected ratios without absorption based on existing and extrapolated cross-sections (Fig. 2 gray line). A clear K^- disappearance for a higher effective density is observed, which is even more evident for low momenta. Moreover the ratios yield to a K^- absorption in all four kinetic observables.

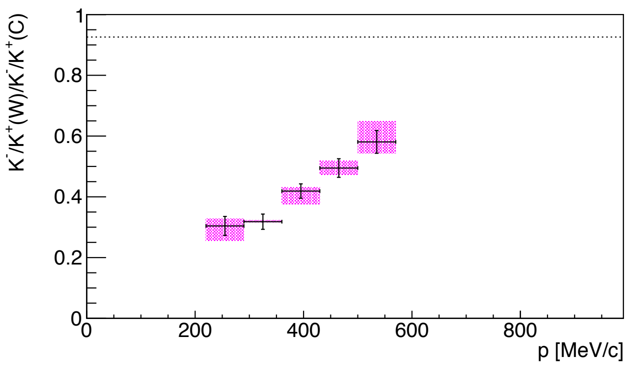

Figure 2: K^-/K^+ ratio in $\pi^- + W$ collisions compared to $\pi^- + C$ as a function of momentum. The gray line reflects the expected double ratio without absorption.

References

[1] J. Schaffner et al., "In-medium production of kaons at the mean field level", Nucl. Phys. A625: p. 325 – 346 (1997)

[2] M. L. Benabderrahmane et al., "Measurement of the in-medium K0 inclusive cross section in π^--induced reactions at 1.15 GeV/c", Phys. Rev. Lett. 102, 182501 (2009)

[3] G. Agakishiev et al.: "Medium effects in proton-induced K0 production at 3.5 GeV", Phys. Rev., Bd. C90: p. 054906 (2014)

[4] W. Scheinast et al., "First observa-tion of in-medium effects on phase space distributions of an- tikaons measured in proton-nucleus collisions," Phys. Rev. Lett. 96, 072301 (2006)

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