Differences in population of the phase space for $K^{\pm}$-mesons produced in π-induced reactions with heavy and light targets. *

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In hot and dense baryonic matter, several non-trivial in-medium effects such as partial restoration of chiral symmetry, the modification of baryon-meson couplings, and the nuclear potentials are expected. As a result the properties of hadrons (e.g. mass, width, dispersion relation) may change. For K-mesons these changes are parametrized as a density dependent mean field $KN(\bar{K}N)$-potential, repelling(attracting) the kaons(anti-kaons) toward nucleons [1]. In pion-induced reactions these potentials can be studied at normal nuclear matter density.

The FOPI Collaboration in cooperation with the GEM-TPC Collaboration has recorded about 4M $\pi^- + {}^{208}Pb$ collisions and 3M $\pi^- + {}^{12}C$ collisions in the S339 experiment. After background subtraction about 16000 K^+- and about 450 K^--candidates produced in C target, 19000 K^+- and about 230 K^--candidates in Pb target could be identified. Both K^+- and K^--mesons could be measured down to $p_K = 0.1 GeV/c$ disclosing the most sensitive phase space region for $KN(\bar{K}N)$-potential investigation.

To see a possible influence from nuclear potentials we evaluate the momentum distributions of K-mesons. The momentum distribution of K^+-mesons produced in Pb-target $((dN/dp)_{Pb})$ should be shifted to higher momenta with respect to the one of K^+-mesons from the C-target$((dN/dp)_C)$ due the stronger repulsion felt by the K^+-mesons emitted from the heavier nucleus.. The 'momentum ratio' $R((d\sigma/dp)_{Pb}/(d\sigma/dp)_C)$ (normalized to the geometrical cross section) is expected to undergo a maximum. Fig.1 (upper panel) shows the result for K^+-mesons from the recent data sample. This measurement is in qualitative agreement with the previous results by the FOPI Collaboration (K^0_S measurement [2]) and ANKE collaborations (K^+ measurement [3]) showing a maximum around $p_{K^+} = 0.25 GeV/c$ and confirming the expected behavior for the repulsion scenario. However we do not observe the strong decrease, as seen bei ANKE, at smaller momenta, possibly due to different intermediate states.

Since K^- are attracted to nucleons, the 'momentum ratio' would have the largest value at smallest momentum and decrease with increasing momenta. Fig. 1 (lower panel) reveals that K^--mesons show a nearly constant ratio, which might be due to the strong absorption in nuclear matter. The observed K^--mesons are emitted from the surface of the target nuclei, do not feel the $\bar{K}N$-potential within the nucleus, and therefore have the same phase space distribution in both targets. The beam momentum of 1.7 GeV/c allows the direct production of K^+K^--pairs and hence also the production of intermediate ϕ-mesons decaying to K^+K^- (48.9 % BR). Currently it is not clear to which extent the observed K^--mesons originate from ϕ-meson decays.

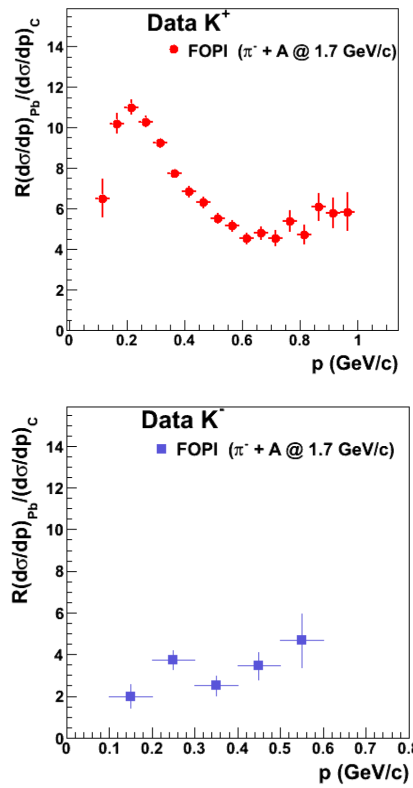

Figure 1: The 'momentum ratio' of K^+(upper panel) and K^- (lower panel). See text for details.

To obtain a consistent description of strangeness, especially K^-, in nuclear matter we intend to evaluate further particles connected to K-mesons by production/absorption. In the further analysis steps phase space distributions of particles like K^0 - mesons, ϕ-mesons and Λ-baryons produced in light and heavy systems will be evaluated.

References

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