# Charged kaon production in pion-nucleus reactions at 1.7 GeV/c*

*L. Fabbietti*[1,2], *K. Lapidus*[†1,2], *A. Scordo*[3], *and the HADES collaboration*

[1]Physik Department E12, Technische Universität München, 85748 Garching, Germany; [2]Excellence Cluster 'Origin and Structure of the Universe' , 85748 Garching, Germany; [3]INFN Laboratori Nazionali di Frascati, 00044 Frascati (Roma), Italy

The production of strangeness in pion-nucleus reactions allows to probe effects of cold nuclear matter, such as the modification of the hadron spectral functions at zero temperature and normal nuclear density. The kaons ($K^+$, $K^0$), produced inside the nucleus, are characterized by a relatively large mean free path ($\lambda \approx 5$ fm for $p_K < 900$ MeV$/c$) and feel a repulsive potential of moderate strength (about $+30$ MeV [1], cf. discussion in [2]). The case of antikaons ($K^-$) is much more involved, as these hadron species propagate in an attractive potential that has a sizeable imaginary part, related to the in-medium absorption. Existing data on the in-medium effects in the antikaon production at nuclear targets are very scarce [3].

In summer 2014 the HADES collaboration successfully performed a pilot pion beam run ($p = 1.7$ GeV$/c$) employing carbon and tungsten targets. For each target more than 100 million of events were collected. Charged kaons can be reconstructed by means of time-of-flight and momentum measurements combined in the mass observable. For $^{12}$C and $^{184}$W targets, separately, about $100 \times 10^3$ $K^+$'s and $10 \times 10^3$ $K^-$'s were reconstructed (Fig. 1). The rich statistics of the charged kaon sample allows to perform a two-dimensional analysis of the kaon phase space.

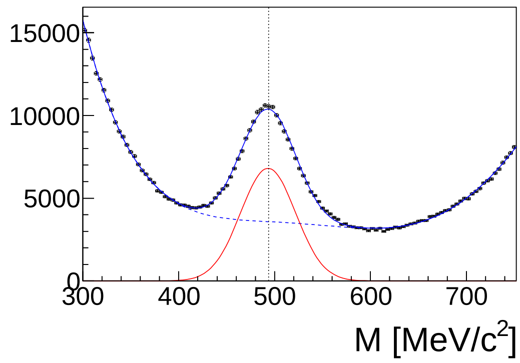


Figure 1: $K^+$ signal in the mass spectrum of positively charged particles ($\pi$C run). The dashed vertical line shows the nominal charged kaon mass. A fit with a gaus (signal) plus a 5th order Chebyshev polynomial (background) is shown.

Figure 2 shows raw doubly-differential (transverse momentum vs. rapidity) yields of $K^+$'s reconstructed in the pion-carbon run. Thanks to the high statistics of the data sample and the large acceptance of the HADES setup, a major part of the kaon phase space can be accessed. This will allow, after the application of necessary efficiency corrections, to extrapolate the kaon yield to the full solid angle and extract the production cross section. The FOPI collaboration has demonstrated [1], that for the pion beam the total $K^0$ production cross section scales with the surface of the target nucleus ($\sigma_{tot}^{K^0} \propto A^{2/3}$, where $A$ is the mass number). An analogous behaviour is expected for $K^+$'s. The new HADES data allows to extract the $A$-dependence of the production cross section for antikaons as well, which till now has not been done for pion-induced reactions. A deviation of the exponent from the value of 2/3 would indicate: a) an increased absorption of the antikaons (a smaller value of the exponent) or b) a decreased threshold for the antikaon production due to the attractive potential (rise of the exponent).

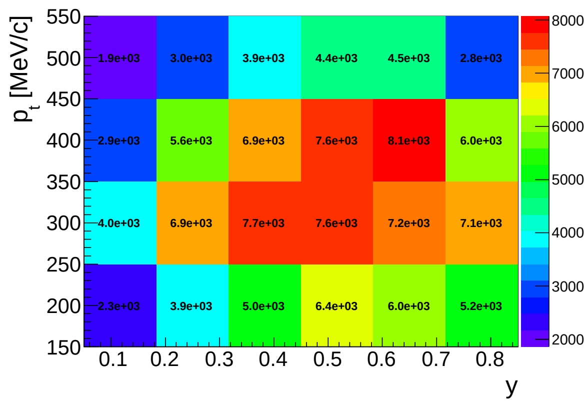


Figure 2: Raw $K^+$ yields extracted in pion-carbon run. No efficiency corrections have been applied.

## References

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† kirill.lapidus@ph.tum.de



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