Dependence of K^+ Production on the System Size at 1.5 AGeV

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The FOPI collaboration has recently measured K^+ production in Ca+Ca, Ru+Ru and Au+Au collisions at 1.5 AGeV [1] to investigate the dependence on system size and to learn more about modification of kaon properties in dense hadronic matter which is eventually connected to the partial restoration of chiral symmetry. Several theoretical models predict that the K^+ mass increases slightly with baryon density whereas the K^- mass should decrease [2, 3, 4, 5, 6]. These medium modifications of the kaon masses lead to a lower probability for K^+ production since it becomes energetically more difficult to produce them and to a higher probability for K^-.
Previous results from FOPI on kaon flow [7] and K^-/K^+ ratio [8] seem to favor the existence of in-medium potentials for kaons derived from the comparison to transport model calculations [9, 10].

The K^+ mesons are identified in the central part of the FOPI detector by a drift chamber (CDC) surrounded by a barrel of plastic scintillators for the measurement of the time of flight. The TOF subsystem covers the polar angular range between 40° and 130°. For a clean identification of K^+ in the Au+Au system a laboratory momentum cut of $p < 0.4$GeV/c is required. This cut is also applied to the other systems in order to select the same region of the phase space although K^+ can be identified in the lighter collision systems up to p=0.5 GeV/c. A simulation of the FOPI detector response based on the GEANT package is used to estimate the tracking efficiency in each system. The results vary between 87% for the Au system and 99% for the Ca system. The data are further corrected for the matching efficiency between the CDC and the TOF barrel that is estimated from proton tracks and for the kaon lifetime.

Figure 1 shows the number of K^+ per participant as function of the number of participants for Ca+Ca, Ru+Ru and Au+Au at 1.5 AGeV. The charged particle multiplicity measured in the forward plastic wall of the FOPI detector has been used to select central collisions corresponding to 10% of the total cross section. The data are shown by the circles, the error bars include statistical and systematical errors. The experimental results are compared to the predictions of transport models, RBUU [10] (upper panel) and IQMD [11] (lower panel). These calculations are available in two versions: the first one employs the free kaon mass (triangles), the other one includes modified masses (squares), i.e. the K^+ mass depends linearly on density with an increase of 5% at normal nuclear matter density. Within errors the data do not show any dependence on the system size whereas both models consistently predict an increase of the kaon production with the system size. This increase is slightly more pronounced in the absence of medium effects. In both cases, in addition the absolute yields are better described by the versions including the in-medium modification of the K^+ mass.

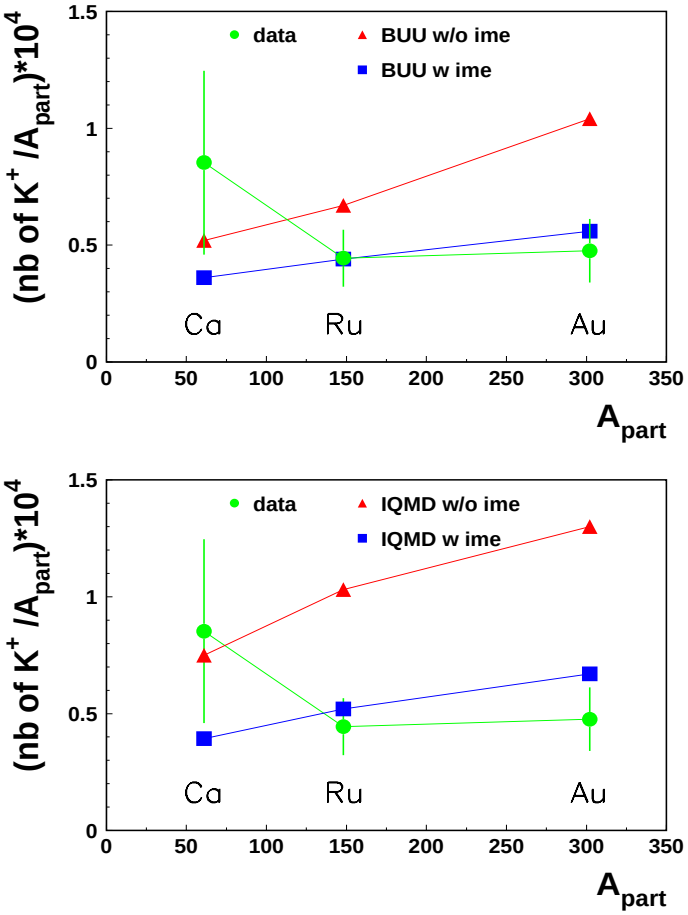

Figure 1: *Number of K^+ per participant as function of the number of participant in Ca+Ca, Ru+Ru and Au+Au collisions at 1.5 AGeV. The data (circles) are compared to the predictions of RBUU (upper) panel and IQMD (lower panel) with in-medium modification of kaon mass (squares) and without (triangles).*

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