$\pi - \Xi$ correlations in Au-Au collisions at RHIC

P. Chaloupka[1], F. Retière[2,3]

[1]*Nuclear Physics Institute AS CR, 250 68 Řež/Prague, Czech Republic*

[2]*Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720*

[3]*TRIUMF, Vancouver, British Columbia, Canada*

Previous STAR measurements of spectra and elliptic flow suggest that the hot and dense system created in high-energy Au-Au collisions builds up substantial collective behavior leading to a rapid transverse expansion. Because of their presumably small hadronic cross-section[1] Ξs are expected to undergo few interactions in the hadronic phase, hence picking up less flow and decoupling earlier than Λ, K, p. Therefore Ξs are likely to carry more direct information about the partonic stage than other hadrons. Recent measurements[2] show multi-strange baryons Ξ and Ω developing substantial elliptic flow comparable to other particles species while decoupling at higher temperature and lower transverse radial flow velocity[3]. This may imply that early partonic collectivity was achieved in the Au-Au collisions.

Final state non-identical particles correlations provide a way of measuring space-time properties of the particle-emitting source allowing to probe relative space-time emission asymmetries among two particle species. Such an asymmetry would arise either from different decoupling times and/or as a consequence of the collective expansion when heavier particles are on average emitted closer to the surface of the source than the lighter ones[4]. Further insight into the dynamics and independent cross-check of the particle elliptic flow can thus be provided by studying non-identical particles correlation function. For such a study, system with a large mass difference, like $\pi - \Xi$, is therefore of a high interest.

We analyze $\pi - \Xi$ correlation function $C(k^*)$, constructed in a pair rest frame, where $\vec{k}^* = \vec{p}^*_\pi = -\vec{p}^*_\Xi$. The $C(k^*)$ is obtained as a ratio of k^* distribution of real $\pi - \Xi$ pairs from individual events divided by a mixed-event pair distribution, in which each particle was taken from a different event. STAR detector at RHIC is used to reconstruct charged Ξs via their decay topology: $\Xi \rightarrow \Lambda + \pi$,and subsequently $\Lambda \rightarrow \pi + p$. Datasets of Au-Au collisions at two energies, $\sqrt{s_{NN}} = 200\, GeV$ and $\sqrt{s_{NN}} = 62.4\, GeV$, were processed. In FIG. 1 we present preliminary results on $C(k^*)$ for all four combinations of $\pi^\pm - \Xi^\pm$ pairs from the 10% most central 200 GeV Au-Au collisions. In the same figure are shown theoretical predictions[5] for which the size of the system was taken from a hydrodynamically inspired model[4] under assumption of both particle developing the same flow. In the low k^* region ($k^* < 0.05\, GeV/c$) the correlation function is dominated by Coulomb interaction. Final state strong interaction is manifested in a peak at $k^* \approx 0.15\, GeV/c$, corresponding to $\Xi^*(1530) \rightarrow \Xi + \pi$ decay. FIG. 2 shows centrality dependence of $C(k^*)$ for combined $\pi^+ - \Xi^-$ and $\pi^- + \Xi^+$ pairs. In the same figure we show result from RQMD model for the corresponding most central bin. RQMD model contains no hot partonic phase and can thus be used to study effects of the hadronic phase on the correlation function. The model produces $\Xi^*(1530)$ signal, but has no long range final state Coulomb interaction. Coulomb part of the real data correlation function is affected by the low statistics, however the region of $\Xi^*(1530)$ shows strong centrality dependence and thus allows for fitting and model comparison.

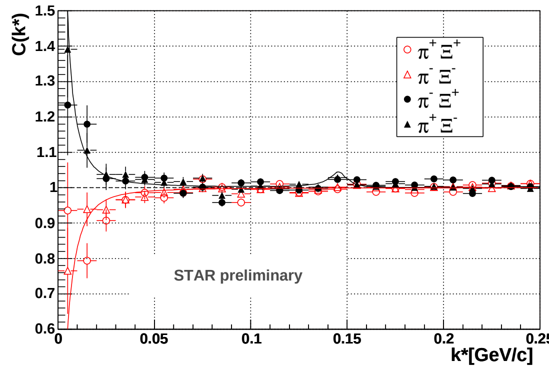

FIG. 1: $\pi - \Xi$ correlation function for 10% most central AuAu collisions at 200 GeV. Triangles and circles are experimental data, solid lines are theoretical predictions.

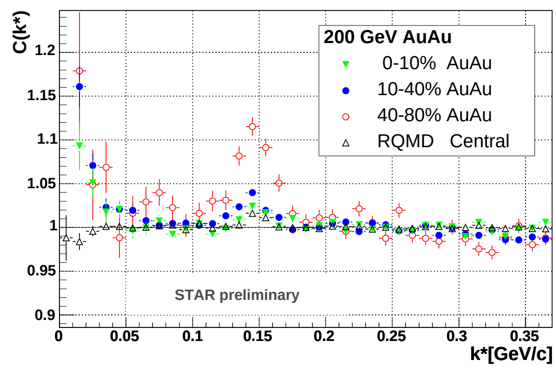

FIG. 2: Centrality dependence of $C(k^*)$ for unlike-sign $\pi - \Xi$ pairs. Open triangles show RQMD model predictions for the most central bin.

[1] H. van Hecke, H. Sorge, and N. Xu, Phys. Rev. Lett. **81**, 5764 (1998).

[2] J. Adams et al. (STAR) (2005), nucl-ex/0504022.

[3] M. Estienne (STAR), J. Phys. **G31**, S873 (2005).

[4] F. Retiere and M. A. Lisa, Phys. Rev. **C70**, 044907 (2004).

[5] S. Pratt and S. Petricioni, Phys. Rev. C **68**, 054901 (2003).