Probing Baryon Number Transport and Strangeness Production Dynamics with Hyperon-kaon Correlations

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QUICK LINKS

1. Introduction

Recently, positive net-baryon number was observed in mid-rapidity region in heavy-ion collisions. [?] [?] Since every initial baryons carry beam rapidity, there must be baryon number transport from beam rapidity to mid-rapidity (named BNT). During these baryons be stopped with rapidity gap $\Delta y = y - y_{beam}$ (y is the final baryons rapidity, and y_{beam} is the beam rapidity), quark and anti-quark may be pair producted, and the anti-quarks with some of the valence quarks in initial baryons may consist mesons. These final baryons will correlate with these by-producted mesons. If those quark and anit-quark pairs are strangeness quarks, just as showed in Fig. 1, these correlated hyperons and kaons can be used to measured to observe this baryon number stopping process. Since the hyperons and Kaons must come from the collisions, they will be better candidates to measure compareing the protons/neutrons and pions.

There are two baryon model discribing baryon stopping, Valence quraks picture and Baryon junction model picture [?]. In valence quark picutre, each valence quarks in baryons carry $1/3$ baryon number, while in baryon junction model picture, that is one Y-shape gluon field connected to 3 valence quarks carry one baryon number. Since the valence quark carry small x and gluon field carry large x, gluon field have more time to join the interaction during collision and hence are more possible be stopped in mid-rapidity than the valence quarks. Therefor, the baryon junction model will be a better candidate to describe the baryon stopping observed in experimental data.

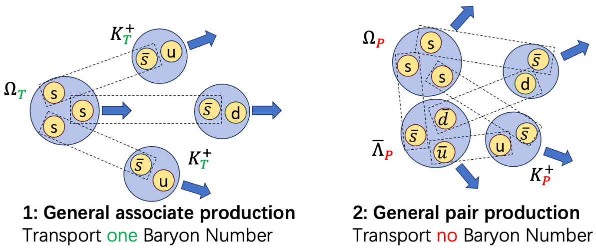
In this work, we will present a new method to observe the baryon stopping by measureing the Kaons-hyperons correlation, and our result may be able to work as a bench mark for future experimental analysis.

2. Correlation Function

To measure the Kaon-Hyperons correlation, their pairs distribution P_{KH}^{same} in same events and P_{KH}^{mix} in mix events have been calculated, here P_{KH}^{mix}] has been scaled to ensure $\sum_{pairs} P_{KH}^{mix} = \sum_{pairs} P_{KH}^{same}$.

According to hyperons production process, there are two scenarios of production of hyperons, just as showed in Fig. 1 where Ω is showed as example. Just as Fig. 1 show, there is three kinds of Kaons: K_T, K_P and K_U, denote the Kaons produced in scenario 1, 2 and do not correlate with any baryons. There is two kind of hyperons: H_T and H_P, repersant the hyperons producted with and without BNT.

By



Clip 1: Two scenarios of production of Ω. Left: General associate production; Right: General pair production. The circles within the dashed box denote $s-\bar{s}$ quark pair produced, those u and d quarks without the dashed box come from initial baryons, hence there is BNT in scenario 1.