NEAR-SIDE DIHADRON CORRELATIONS AT RHIC*

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Results on dihadron correlations at near-side at RHIC ($\sqrt{s_{NN}} = 200$ GeV) are presented. In addition to the jet-like component, long-range pseudo-rapidity ($\Delta\eta$) correlations, *the ridge*, are observed in Au+Au collisions. Properties of the jet- and ridge-like correlations are discussed as a function of collision centrality, transverse momentum and particle composition. The results are confronted with recent model predictions.

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Dihadron azimuthal correlations are commonly used to study jet related processes in heavy-ion collisions where full jet reconstruction is difficult due to large background formed by soft particles. One of the remarkable features of the correlations in Au+Au collisions at RHIC is the observation of an additional long-range pseudo-rapidity correlation on the near-side, *the ridge*, which is absent in p+p and d+Au collisions [1, 2]. Fig. 1 shows the dihadron distribution in $\Delta\eta \times \Delta\phi$ space for charged trigger particles

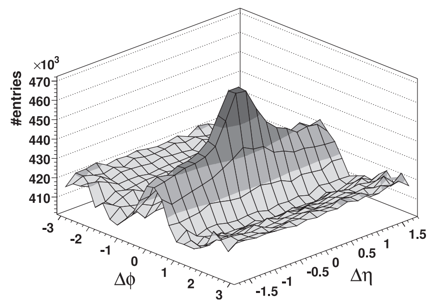

Fig. 1. Raw $\Delta\eta \times \Delta\phi$ dihadron correlation function in central Au+Au collisions for $3\,\mathrm{GeV}/c < p_{\mathrm{T}}^{\mathrm{trig}} < 4\,\mathrm{GeV}/c$ and $p_{\mathrm{T}}^{\mathrm{assoc}} > 2\,\mathrm{GeV}/c$. The figure is taken from [2].

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with transverse momentum $3 < p_{\rm T}^{\rm trig} < 4\,{\rm GeV}/c$ and associated charged particles with $p_{\rm T}^{\rm assoc} > 2\,{\rm GeV}/c$ produced in central Au+Au collisions [2]. As expected from jet fragmentation, there is a clear peak present around $(\Delta\eta,\Delta\phi) = (0,0)$, which is accompanied by an extended correlation in $\Delta\eta$, the ridge. Below we discuss properties of the ridge and jet-like correlations. Analysis details can be found in [2, 3].

The centrality dependence of ridge and jet yields of charged particles associated with charged and strange (Λ, $K_{\rm s}^0$) trigger particles in Au+Au collisions at $\sqrt{s_{NN}} = 200\,{\rm GeV}$ is shown in Fig. 2. For all studied trigger particle species, the yield of charged particles associated with the ridge shows a significant increase by a factor of 3–4 going from d+Au to central Au+Au collisions. In contrast, the jet yield is within errors independent of centrality and consistent with that in d+Au collisions.

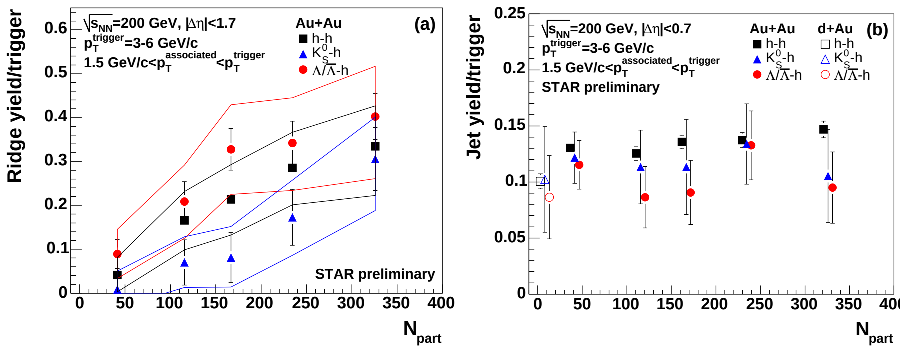

Fig. 2. Centrality dependence of the ridge yield (a) and jet yield (b) of associated charged particles for various trigger species in d+Au and Au+Au collisions as indicated by the legend. The error bands represent systematic errors on the ridge yield due to the subtraction of elliptic flow (v_2). The figure is taken from [3].

It is interesting to study the $p_{\rm T}$ range for which the ridge-like correlations exist. The left panel of Fig. 3 shows the dependence of the near-side yield of associated charged particles with $p_{\rm T}^{\rm assoc} > 2\,{\rm GeV}/c$ on $p_{\rm T}^{\rm trig}$. Please note that due to statistics limitations only the results for charged trigger particles are shown. The ridge yield persists up to the highest $p_{\rm T}$ currently available, $p_{\rm T}^{\rm trig} \approx 9$ GeV/c, and is approximately independent of $p_{\rm T}^{\rm trig}$. The fact that the ridge exists in the $p_{\rm T}$ domain where parton fragmentation is expected to govern the particle production indicates that its physics origin is associated with jet production. A more detailed study of the $p_{\rm T}$ spectra of particles associated with the ridge in different $p_{\rm T}^{\rm trig}$ windows and its comparison to the $p_{\rm T}$ spectra of particles produced in the bulk and associated with the jet is presented in Fig. 3 (right). The inverse slope extracted from an exponential fit to the $p_{\rm T}$ spectra is for the ridge-like yield independent of $p_{\rm T}^{\rm trig}$ and only slightly larger (by $\approx$ 40–50 MeV) than the inclusive $p_{\rm T}$ spectrum. The jet-like yield has a significantly harder spectrum, with an inverse slope increasing steeply with $p_{\rm T}^{\rm trig}$ in line with jet fragmentation.

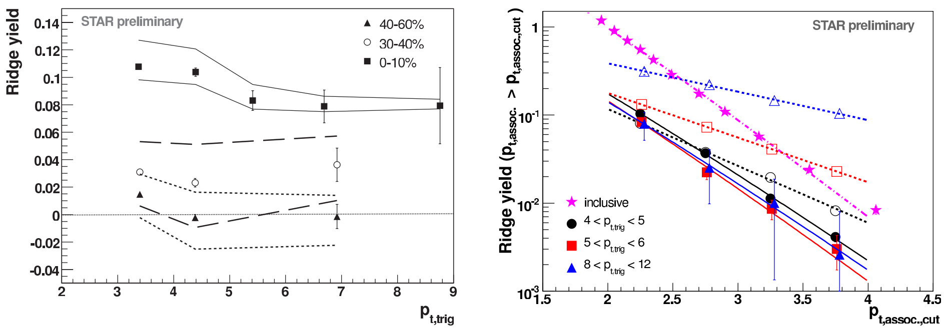

Fig. 3. Left: $p_{\rm T}^{\rm trig}$ dependence of ridge yield for $p_{\rm T}^{\rm assoc} > 2\,{\rm GeV}/c$ and several centralities in Au+Au collisions. Right: Ridge and jet yields (filled/open symbols) as a function of $p_{\rm T}^{\rm assoc}$ for different $p_{\rm T}^{\rm trig}$ in 0–10% central Au+Au collisions. The inclusive $p_{\rm T}$ spectrum (stars) is also shown. The figures are taken from [2].

It is also important to investigate particle composition in the ridge. In [4] a preliminary study of charged particle triggered correlations with associated strange particles (Λ, $K_{\rm S}^0$) in central Au+Au collisions has been carried out. Fig. 4 shows the extracted $\Lambda/K_{\rm S}^0$ ratio in the jet and ridge together with the ratio obtained from inclusive $p_{\rm T}$ spectra. The $\Lambda/K_{\rm S}^0$ for the jet is consistent with the ratio measured in p+p. There is a hint that the $\Lambda/K_{\rm S}^0$ ratio in the ridge is higher than in the jet, however, more data are needed to draw a definite conclusion.

The observation of the ridge phenomenon has lead to intense theoretical discussions and several models are qualitatively able to explain its origin. The large increase of the ridge yield in Au+Au with respect to d+Au collisions together with enhanced baryon/meson ratios can be understood in the framework of the parton recombination [8]. The interaction of high-$p_{\rm T}$ partons with a dense medium and coupling of the induced gluon radiation to longitudinal flow is predicted to form a ridge in $\Delta\eta$ as well [9]. The mechanism suggested in [10] relates the ridge to spontaneous formation of extended color fields in a longitudinally expanding medium due to the presence of plasma instabilities. The effects of momentum broadening in an anisotropic plasma induced by energy loss have been studied in [11]. A completely different mechanism for the ridge origin is based on jet quenching and strong radial flow [12,13]. In the momentum kick model [14], partons in the medium suffer a collision with a jet and acquire a momentum kick along

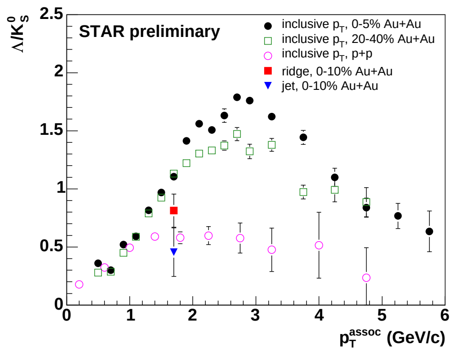

Fig. 4. $\Lambda/K^0_{\rm S}$ ratio measured in inclusive $p_{\rm T}$ distributions and in near-side jet and ridge-like correlations in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV together with the ratio from inclusive $p_{\rm T}$ spectra in $p+p$ collisions. The figure is taken from [4].

the jet direction forming a ridge structure. At this stage more quantitative model predictions as well as further studies of the ridge particle composition and studies at forward rapidities are needed to bring more insights into the ridge physics origin.

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