Experimental constraints on fragmentation functions for strange hadrons in $p+p$ collisions at $\sqrt{s} = 200$ GeV at RHIC

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1 Summary of Talk

Perturbative QCD has proven successful in describing inclusive hadron production in elementary collisions. Within the theory's range of applicability, calculations at next-to-leading order (NLO) have produced accurate calculations for the transverse momentum spectra of charged hadrons in different collision systems and energy scales, which has lead to claims of their universality [1]. With the new mid-rapidity $p+p$ data at $\sqrt{s} = 200$ GeV collected at RHIC, comparisons to pQCD can now be extended to identified strange baryons and mesons [3].

In the last 5 years significant improvements have been made in the field of NLO fragmentation function (FF) parameterizations. Several groups have updated their parameterizations to include not just $e^+ + e^-$ but also (SI)DIS and now $p+p$ data, therefore improving the constraints on the parameters in the FF. In particular the gluon-to-hadron FF was never well constrained by $e^+ + e^-$ and DIS data since the probability of gluon-jets was low. Conversely, at RHIC we are probing a very gluon-jet rich parton stage and the majority of final states are produced by gluons. In particular baryons are dominated by gluon fragmentation. In fact, according to AKK-FF protons below p_T 10 GeV/c are produced to 90% from gluons and only 10% from quarks. On the other hand pions are produced in equal parts by gluons and quarks.

Experimentally this fact can be exploited by computing the baryon-to-meson ratios and fitting them to LO/NLO calculations. Results by the STAR collaboration confirm that LO models are not able to accurately describe this ratio [2, 3] and underpredict the amount of baryons at low p_T. For strange baryon production (Λ) first NLO predictions equally fail to describe the data [4]. In an attempt to solve this shortcoming one group (AKK) [5] adjusted the gluon FF until it fit the data. They found the best result for $D_g^\Lambda = D_g^p/3$. Another group

(DSS) has for the first time performed seperate fits to protons and anti-protons based on STAR data [6]. They also publish FF for pions, kaons and charged hadrons from a global analysis [7].

Another subject which did not receive sufficient attention up until recently are error estimations on the FF parameterizations. One group (HKNS) [8] has now published a global (hessian) error analysis for charged hadrons and finds that the 4 most ubiqitious FF agree within errors. However this analysis does not include $p + p$ data.

The STAR experiment has also measured identified particle spectra in terms of m_T ($=\sqrt{p_T^2 + m^2}$) which is motivated by a some earlier papers [9]. After arbitrary normalization of the different particle species, this representation clearly shows different shapes of the spectra for the baryons and mesons for $m_T > 2$ GeV/c. Interestingly, a simulation of the same observable with PYTHIA (LO pQCD) shows a similar feature when selecting gluon-jet enriched events [10].

Finally, efforts at RHIC are now being focused in order to extract medium modified FF. Several approaches are being pursued in parallel, such as Di-hadron correlations, 3-particle correlations and also full jet reconstruction.

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