



XXIV QUARK MATTER DARMSTADT 2014

Contribution ID: 113

Type: Poster

E_T distributions in p+p, d+Au and Au+Au at $\sqrt{s_{NN}} = 200$ GeV and analysis based on Constituent-Quark-Participants

Tuesday 20 May 2014 16:30 (2 hours)

Measurements of mid-rapidity $dE_T/d\eta$ distributions in p+p, d+Au and Au+Au at $\sqrt{s_{NN}} = 200$ GeV by PHENIX at RHIC are presented and analyzed in terms of the number of Constituent-Quark participants, N_{qp} . This provides a physical way to introduce fluctuations in Glauber Model calculations of p+p collisions, since the spatial distribution of each of the three constituent quarks in a nucleon is generated according to the measured charge distribution of the proton. It had been noted previously that $dN_{ch}/d\eta$ at mid-rapidity in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV as a function of centrality is not simply proportional to the number of nucleon participants, N_{part} , (the Wounded Nucleon Model, WNM) but is linearly proportional to the number of constituent-quark participants, N_{qp} , (the NQP model). For symmetric systems, the NQP model is identical to the Additive Quark Model (AQM) used in the 1980's, to explain a similar disagreement of $dE_T/d\eta$ distributions with the Wounded Nucleon Model in $\alpha + \alpha$ relative to p+p collisions at $\sqrt{s_{NN}} = 31$ GeV at the CERN-ISR. However, the AQM and NQP models differ for the case of asymmetric systems such as d+Au, where the AQM, which is a color-string model, is effectively proportional only to the number quark-participants in the projectile. The present d+Au data clearly reject the AQM model in favor of the NQP, which is also in excellent agreement with the Au+Au data. The NQP model also explains why the additional contribution proportional the number of binary-collisions, N_{coll} , added to N_{part} to parametrize the centrality-dependence of A+A collisions works, but does not imply a hard-scattering component in E_T distributions and thus is no longer in disagreement with lessons learned from measurements of E_T distributions in p+p(\bar{p}) collisions at the CERN SpS, ISR and SpS-Collider.

On behalf of collaboration:

PHENIX

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Session Classification: Poster session

Track Classification: Initial State Physics