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

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Measurements of mid-rapidity $d\mathrm{E}_T/d\eta$ 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 $dN_{\mathrm{ch}}/d\eta$ 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 $d\mathrm{E}_T/d\eta$ 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($\bar{\mathrm{p}}$) collisions at the CERN SpS, ISR and SpS-Collider.