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Large revealing similarity in multihadron production in nuclear and particle collisions

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The dependencies of charged particle pseudorapidity density and transverse energy pseudorapidity density at midrapidity as well as of charged particle total multiplicity on the collision energy and on the number of nucleon participants, or centrality, measured in nucleus-nucleus collisions are studied in the energy range spanning a few GeV to a few TeV per nucleon.

The model in which the multiparticle production is driven by the dissipating effective energy of participants is considered. The model extends the earlier proposed approach, combining the constituent quark picture together with Landau relativistic hydrodynamics shown to interrelate the measurements from different types of collisions. Within this model, the dependence of the charged particle pseudorapidity density and transverse energy pseudorapidity density at midrapidity on the number of participants in heavy-ion collisions are found to be well described in terms of the effective energy defined as a centrality- dependent fraction of the collision energy. For both variables the effective energy approach reveals a similarity in the energy dependence obtained for the most central collisions and centrality data in the entire available energy range. The total multiplicity dependencies on the collision energy and on the centrality reveals different behaviour at energies up to RHIC top energy compared to the LHC data. The total multiplicity dependencies measured at RHIC are found to be well reproduced as soon as the fragmentation area of the pseudorapidity distribution is taken into account within the limiting fragmentation approach. The measurements at the LHC are well described by the model demonstrating no fragmentation in the data. Given the total multiplicity dependence on centrality is well described, the most central collision data on the multiplicity and the multiplicity centrality data show their complementarity in the energy dependence similar to the charged particle and transverse momentum densities. Predictions are made for the investigated dependencies for the forthcoming higher energy measurements in heavy-ion collisions at the LHC.

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