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Editorial

Multiparticle Production in High Energy Collisions

Fu-Hu Liu,[1,2] Sakina Fakhraddin,[3,4] and Bhartendu K. Singh[5]

[1] *Institute of Theoretical Physics, Shanxi University, Taiyuan, Shanxi 030006, China*
[2] *Department of Chemistry, Stony Brook University, Stony Brook, NY 11794-3400, USA*
[3] *Physics Department, Faculty of Science, Sana'a University, P.O. Box 1247, Sana'a, Yemen*
[4] *Physics Department, Science & Arts Faculty (Girls Division), Najran University, P.O. Box 1988, Najran, Saudi Arabia*
[5] *Physics Department, Banaras Hindu University, Varanasi 221 005, India*

Correspondence should be addressed to Fu-Hu Liu; fuhuliu@163.com

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The nuclear collisions at relativistic energy offer the right kind of environment to explore a variety of phases transitions related to hot and dense nuclear matter to enhance our existing knowledge about the formation and decay of highly excited nuclear matter. The compression of nuclear matter and its subsequent expansion result in production of particles along with the disassembly of the expanded nuclear system into multiparticle production. Multiparticle production is the "first-day" research topic in the collisions and is related to the state of deconfined quarks and gluons (quark gluon plasma (QGP)) which is predicted by the quantum chromodynamics (QCD). Multiparticle production is especially related to the statistical properties of global observables, dynamical evolution of interacting system, various distributions and correlations, and so on.

From fixed target experiments to collider experiments, multiparticle production research covers various collisions over an energy range from GeV to TeV. Previously, a few accelerators provided hadron and heavy ion beams for the studies of multiparticle production. Presently, the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory (BNL) and the Large Hadron Collider (LHC) at European Laboratory for Particle Physics (CERN) provide proton and heavy ion beams for our studies.

This special issue concerns many topics in the multiparticle production in high energy collisions, for example, multiplicity distributions and correlations, rapidity or pseudorapidity distributions and correlations, transverse momentum distributions and correlations, anisotropic flow effects and correlations, statistical and dynamical fluctuations, final-state distributions and dynamical evolution, final-state distributions and statistical behaviors, and others.

The paper "*Charged hadron multiplicity distribution at relativistic heavy ion colliders*" reviews the facts and problems concerning the charged hadron productions in high energy collisions. Main emphasis is laid on the qualitative and quantitative description of general characteristics and properties observed for charged hadrons produced in such high energy collisions. Various features of available experimental data including the variations of charged hadron multiplicity and pseudorapidity density with the mass number of colliding nuclei, center-of-mass energies, and the collision centrality obtained from heavy ion collider experiments are interpreted in the context of various theoretical concepts and their implications. Several important scaling features observed in the measurements mainly at RHIC and LHC experiments are highlighted in the view of these models to draw some insight regarding the particle production mechanism in heavy ion collisions.

The paper "*Particle production in ultrarelativistic heavy-ion collisions: a statistical-thermal model review*" presents the current status of various thermal and statistical descriptions of particle production in the ultrarelativistic heavy ion collisions experiments. The formulation of various types of thermal models of a hot and dense hadron gas and the methods incorporated in the implementing of the interactions between hadrons are discussed. Meanwhile, the authors' new excluded-volume model which is thermodynamically consistent is presented. The modeling results are compared with the experimental data of various ratios of the produced hadrons. Some new universal conditions, various transport properties, and different particle spectrums are obtained.

The paper "*Meson production in high energy p+p collisions at the RHIC energies*" studies the transverse momentum spectrum of mesons produced in proton-proton collisions in the framework of a thermalized cylinder model which is now renamed to the multisource thermal model. It is shown that in the region of high transverse momentum, the considered distributions have a tail part at the maximum energy of RHIC. A two-component distribution based on the improved cylinder model is used to fit the experimental data of the PHENIX Collaboration. The improved approach describes well the meson productions in a wider range of transverse momentums.

In the paper "*Charged-hadron pseudorapidity distributions in p-p and Pb-Pb collisions at LHC energies*," the authors study the pseudorapidity distributions of charged hadrons produced in proton-proton and lead-lead collisions measured by the CMS and ALICE Collaborations at LHC energies. An improved Tsallis distribution in the two-cylinder model is used to describe the pseudorapidity spectrums. In the study, the rapidity shift at the longitudinal direction in the geometrical picture of the collisions is considered. It is shown that the calculated results are in agreement with the experimental data. The gap between the projectile cylinder and the target cylinder increases with the centrality. Meanwhile, the rapidity shifts in the cylinders increase with the centrality, too.

In the paper "*Wavelet analysis of shower track distribution in high-energy nucleus-nucleus collisions*," the authors perform a continuous wavelet analysis for pattern recognition of charged particles produced in high energy silicon and sulphur induced heavy ion interactions in nuclear emulsion and try to identify the collective behavior in multiparticle production. The wavelet results are compared with a model prediction based on the Ultrarelativistic Quantum Molecular Dynamics (UrQMD), where a charge reassignment algorithm to modify the UrQMD events to mimic the Bose-Einstein type of correlation among identical mesons is adopted. Statistically significant deviations between the experiment and the simulation are interpreted in terms of nontrivial dynamics of multiparticle production.

In the paper "*Entropy analysis in relativistic heavy-ion collisions*," the authors study the entropy creation in multiparticle system by analyzing the experimental data on ion-ion collisions at AGS and SPS energies. Their results are compared with those predicted by multiphase transport and correlation-free Monte Carlo models. Some interesting results are obtained. Entropies produced in limited- and full-phase space are observed to increase with increasing beam energy. The entropy values, normalized to the maximum rapidity and plotted against pseudorapidity (bin width also normalized to the maximum rapidity), are found to be energy independent, exhibiting a kind of entropy scaling. Such scaling is observed in the full-phase space as well as in the regions confined to the forward or backward hemispheres.

The paper "*On current conversion between particle rapidity and pseudorapidity distributions in high energy collisions*" discusses the conversion between the particle rapidity and pseudorapidity distributions. It is shown that the two equivalent conversion formulas used currently in experimental and theoretical analyses are incomplete. A revision on the current conversion between the particle rapidity and pseudorapidity distributions is given.

The paper "*On antiproton production in 158 GeV/c proton-carbon collisions and nuclear temperature of interacting system*" analyzes the antiproton production process in high energy proton-carbon collisions by using the multisource thermal model. The transverse momentum, Feynman variable, and rapidity distributions of antiprotons in the nucleon-nucleon center-of-mass system are calculated. The modeling results are compared and found to be in agreement with the experimental data measured by the NA49 Collaboration at 158 GeV/c beam momentum.

This issue brings together a collection of research papers on the multiparticle production in high energy collisions. We hope this will be a useful issue for researchers working in related areas. Meanwhile, we regret that more manuscripts submitted for publication in this issue have not been accepted according to reviewer's reports.

Fu-Hu Liu
Sakina Fakhraddin
Bhartendu K. Singh