Pseudo-rapidity distributions of charged particles in asymmetric collisions using Tsallis thermodynamics

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The pseudo-rapidity distributions of the charged particles produced in the asymmetric collision systems p+Al, p+Au and ^{3}He+Au at $\sqrt{s_{NN}}$ = 200 GeV are evaluated in the framework of a fireball model with Tsallis thermodynamics [1]. The fireball model assumes that the experimentally measured particles are produced by fireballs following the Tsallis distribution and it can effectively describe the experimental data, e.g., see Fig. 1. Our results as well as previous results for d+Au collisions at $\sqrt{s_{NN}}$= 200 GeV and p+Pb collisions at $\sqrt{s_{NN}}$=5.02 TeV validate that the fireball model based on Tsallis thermodynamics can provide a universal framework for pseudo-rapidity distribution of the charged particles produced in

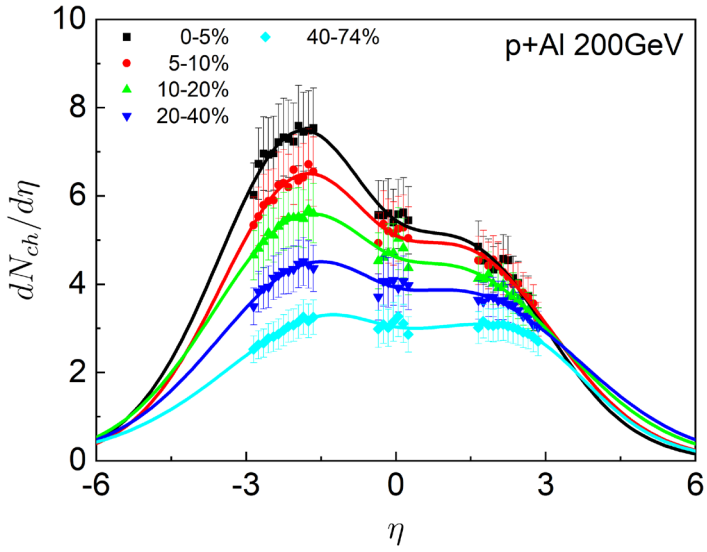

FIG. 1. (Color online) The pseudo-rapidity distributions of the charged particles produced in p+Al collisions at $\sqrt{s_{NN}}$= 200 GeV for different centralities. The symbols are experimental data taken from [2]. The curves are the results from the fireball model with Tsallis thermodynamics.

asymmetric collision systems. We predict the centrality dependence of the total charged particle multiplicity in the p+Al, p+Au, and ^{3}He+Au collisions. Additionally, the dependences of the fireball model parameters (y_{0a}, $y_{\_0A}$, σ_a and σ_A) on the centrality and system size are studied, e.g., see Fig. 2.

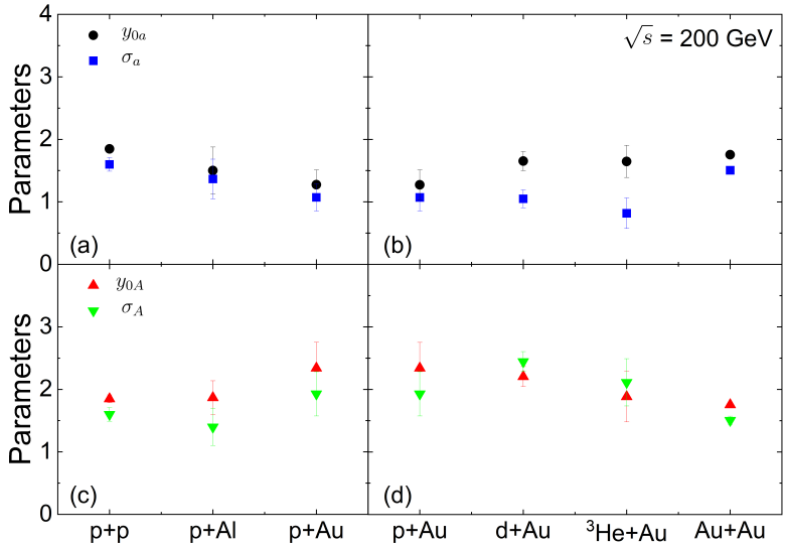

FIG. 2. (Color online) Collision system size dependence of model parameters y_{0a}, $y_{\_0A}$, σ_a and σ_A for p+p, p+Al (0-5%), p+Au (0-5%), d+Au (0-20%), ^{3}He+Au (0-5%) and Au+Au (0-6%) collisions at $\sqrt{s_{NN}}$=200 GeV.

[1] J.Q. Tao, H.B. He, H. Zheng, W.C. Zhang, X.Q. Liu, L.L. Zhu and A. Bonasera, Nucl. Sci. Tech. **34**, 172 (2023).

[2] A. Adare, C. Aidala, N.N. Ajitanand *et al.* (PHENIX Collaboration), Phys. Rev. Lett. **121**, 222301 (2018).