Investigation of possible hadronic flow in p+Pb collisions at the LHC

You Zhou, Xiangrong Zhu, Pengfei Li, and Huichao Song

1Niels Bohr Institute, University of Copenhagen, Denmark
2Department of Physics, Peking University, China

* Presenter Email: xrongzhu@pku.edu.cn

Introduction

❖ The Large Hadron Collider (LHC) has provided strong evidences for the creation of Quark-Gluon Plasma (QGP) in Pb+Pb collisions at 2.76 TeV [1].
❖ The original purpose of p+Pb collisions was to provide reference data for the Pb+Pb collisions, especially on the cold nuclear matter effects.
❖ However, a large amount of unexpected results have been discovered in p+Pb collisions:
   • multi-particle azimuthal correlations [2]
   • mass-dependence of $v_2(p_T)$ of identified particles [3]
❖ Natural question for the created matter:
   • Can QGP be produced in p+Pb collisions?
   • Could this matter be described by hydrodynamics (fluid-like)?

Multi-particle correlations $c_n\{m\}$

❖ A negative sign has been observed for $c_2(4)$ in high multiplicity events in data (indication of flow) while UrQMD simulations only generate positive value of $c_2(4)$ (not a flow signature).

Evidences of flow in p+Pb collisions

❖ Non-zero multi-particle correlations observed in p+Pb collisions
   • evidence of anisotropic flow, claimed by ALICE/ATLAS/CMS Collaborations.
❖ Identified particle $v_2(p_T)$ show mass ordering in p+Pb collisions [3]
   • indication of flow
   • hydrodynamic calculation reproduces the similar feature [4]

Conclusions

❖ The azimuthal correlations in p+Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV are investigated based on the UrQMD model simulations.
❖ Comparison with the experimental data shows that UrQMD cannot reproduce the multiplicity dependence of two- and four-particle cumulants.
   • the simulated hadronic p+Pb systems cannot generate enough collective flow as observed in experiment.
❖ However, the characteristic $v_2(p_T)$ mass ordering of pions, kaons, and protons is observed in UrQMD.
   • the consequence of hadronic interactions
   • not necessarily associated with strong fluid-like expansions.