学位論文要旨

Neutral pion measurement in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV

（核子対あたり重心系衝突エネルギー 5.02TeV の
陽子+鉛原子核衝突における中性パイ中間子の測定）

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Strong suppression of high-$p_{\rm T}$ particles has been observed in heavy-ion collisions at LHC energies, which can be interpreted by invoking various processes involving transport properties of the QCD medium and initial-state effects. Proton-nucleus (p-A) collisions are intermediate between proton-proton (pp) and nucleus-nucleus (A-A) collisions in terms of system size and number of produced particles. Comparing particle production in pp, p-A, A-A reactions has frequently been used to separate initial-state effects of colliding nuclei from final-state effects in quark matter created by the collisions. The study of neutral meson production in proton-lead (p-Pb) collisions at $\sqrt{s_{\rm NN}}$ = 5.02 TeV is of importance to confirm that the strong suppression observed in central lead-lead (Pb-Pb) collisions is a final-state effect of the produced dense medium.

This paper will presents π^0 and η meson production in p-Pb collisions at $\sqrt{s_{\rm NN}} = 5.02$ TeV and nuclear modification factor ($R_{\rm pPb}$) for π^0 from the LHC-ALICE experiment for the first time. The π^0 meson is measured in $p_{\rm T}$ range of $0.3 - 20$ GeV/c via completely methods, using the ALICE electromagnetic calorimeters, PHOS and EMCal, and by the central tracking system, identifying photons converted into e^+e^- pairs in the material of the inner barrel detectors, Time Projection Chamber (TPC) and Inner Tracking System (ITS), called photon conversion method (PCM) In addition, PCM via γ-Dalitz decay channel is denoted as PCM-Dalitz. The η meson is measured in $p_{\rm T}$ range of $0.7 - 20$ GeV/c via EMCal and PCM. The π^0 and η meson final spectra are achieved via combination of individual analyses with weight according to their uncertainties. Both π^0 and η meson invariant yields are a nice agreement by the Tsallis fit and all measurements are consistent with each other within the uncertainties. EPOS3 event generator based on hydrodynamical calculation reproduces well in the almost entire $p_{\rm T}$ region for π^0 and intermediate-$p_{\rm T}$ region for η meson.

The η/π^0 ratio increases at $p_{\rm T} < 4$ GeV/c and arrives a plateau of 0.47 ± 0.02 at $p_{\rm T} > 4$ GeV/c. It is consistent with the ALICE pp and Pb-Pb measurements and the world results. The $m_{\rm T}$ scaling for the η/π^0 ratio is good description at $p_{\rm T} > 4$ GeV/c, but discrepancy is observed in low-$p_{\rm T}$ region. The EPOS3 generator is good reproduction for data in low-$p_{\rm T}$ region and is closer than the $m_{\rm T}$ scaling prediction. But it fails to reproduce data in high-$p_{\rm T}$ region.

The π^0 nuclear modification factor in p-Pb collisions ($R_{\rm pPb}$) increases with $p_{\rm T}$ in low-$p_{\rm T}$ region and consists with unity at $p_{\rm T} > 2$ GeV/c. It is not observed particle yield suppression as observed in Pb-Pb collisions. In addition, the π^0 nuclear modification factor in p-Pb collisions at LHC energy and in d-Au collisions at RHIC energy have no obvious difference. Theoretical model via using EPS09s NLO calculations and CGC model calculation are able to describe $R_{\rm pPb}$. These results provide direction that strong suppression of high-$p_{\rm T}$ π^0 observed in Pb-Pb collisions comes from final state effects due to parton energy loss in the hot QCD medium rather than initial state effects.