Production of hadronic resonances in p–Pb collisions in ALICE at LHC

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Introduction

Hadronic resonances serve as a unique tool to study the properties of hot and dense matter produced in heavy-ion collisions. Several observables can be obtained, starting with the measurement of particle spectra, which provide insights into particle production mechanisms. Resonances have very short lifetime, which are comparable with that of the fireball produced in the collision. Considering that K(892)∗ decays in 7κ = 0 ∼ 4 fm/c and φ(1020) has a lifetime nearly ten times larger than K∗, τφ ∼ 45 fm/c, these particles are excellent probes of the hadronic phase of the collision [1, 2]. The ratios of hadronic resonance yields to the yields of longer-lived hadrons can be used to investigate the re-scattering effects and the chemical freeze-out temperature. Measurements in smaller collision systems such as proton-proton (pp) and proton-nucleus (pA) provide a necessary baseline for heavy-ion data. Studies of resonance production rates have been performed in Pb-Pb collisions [3] and have suggested that re-scattering is a key ingredient in describing measurement. There is therefore great interest in studying this observable in smaller systems.

p–Pb collisions provide a system whose size in terms of average charged-particle density and number of participating nucleons is intermediate between pp and peripheral Pb–Pb collisions.

Resonance reconstruction

The K∗ and φ mesons are measured through invariant-mass reconstruction of their identified decay daughters in the charged hadronic decay channels, K∗0 → K±π∓(K∗0 → K±π+) and φ → K+K−. In p–Pb the rapidity range is restricted to −0.5 < yrms < 0 in order to ensure the best detector acceptance. The combina-

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Results and discussion

The production of K∗0 and φ has been measured in several multiplicity event-classes in p–Pb collisions at √sNN = 5.02 TeV. Fig. 1 shows the transverse momentum (p_T) spectra for φ in different multiplicity event-classes. The p_T integrated particle yields (dN/dy) and mean p_T ⟨p_T⟩ of K∗0 and φ for each multiplicity event class are determined by integrating the p_T spectra in the measured range and by using a Levy-Tsallis fit function to extrapolate

FIG. 1: Transverse momentum spectra of φ for different multiplicity event-classes.
the yield in the \( p_T \) range where no measurement is available. Fig. 2 shows the \( \langle p_T \rangle \) of \( K^{*0} \) and \( \phi \) compared with \( \pi, K, K^0, p, \phi \) and \( \Lambda \) \([4]\) as a function of the average charged particle multiplicity density in pp, \( p\text{--}Pb \) and \( Pb\text{--}Pb \) collisions (\( K^{*0}, p \) and \( \phi \) only). The \( \langle p_T \rangle \) of resonances increases as a function of the average charged particle multiplicity density, as for other hadrons. The \( \langle p_T \rangle \) of long lived hadrons follows mass ordering (particles with higher mass are measured to have larger \( \langle p_T \rangle \)), while the \( \langle p_T \rangle \) of \( K^{*0} \) and \( \phi \) are larger than that of protons, even the \( \langle p_T \rangle \) of \( \phi \) is larger than \( \Lambda \). A similar trend is also observed in pp collisions where \( \langle p_T \rangle \) of \( \phi \) and \( K^{*0} \) is larger than \( p \). The \( (p + \bar{p})/\phi \) ratio is shown in the Fig. 3 for different centrality and multiplicity intervals. In peripheral \( p\text{--}Pb \) and pp collisions the \( (p + \bar{p})/\phi \) ratio is quantitatively consistent below 2 GeV/\( c \) and decreases steeply with \( p_T \), as also observed in peripheral \( Pb\text{--}Pb \) collisions. The ratio in high-multiplicity (0-5%) \( p\text{--}Pb \) is similar to that in 60-80% peripheral \( Pb\text{--}Pb \) collisions, although for the former a hint of flattening is observed for \( p_T < 1.5 \text{ GeV/} c \). Fig. 4 shows the \( K^{*0}/K \) and \( \phi/K \) ratios measured in \( p\text{--}Pb \) collisions compared to the measurements in pp and Pb-Pb. The \( \phi/K \) ratio is nearly flat across all systems and multiplicities and it reaches the value predicted by a grand-canonical thermal model with \( T = 156 \text{ MeV} \). \([5]\). On the other hand, the \( K^{*0}/K \) ratio exhibits a decreasing trend towards more central \( Pb\text{--}Pb \), where the measured ratio is about 60% of the thermal model value. The decrease in the \( K^{*0}/K \) ratio is likely due to re-scattering.

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**References**


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