Deuteron production in Pb–Pb collisions measured with ALICE at the LHC*

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Heavy-ion collisions at the LHC give the opportunity to measure all known particles in higher abundances than it was possible before, like for example light nuclei. These heavy particles are rarely produced, because the production probability decreases with increasing mass. But the energy regime reached at the LHC leads to large production probabilities even for these particles, as described for example by thermal models [1, 2]. The excellent performance of the Time-Projection Chamber (TPC) [3] and the Time-Of-Flight detector (TOF) [4] allows for the clear identification of charged stable particles over a range of 0.15 to 5 GeV/c in rigidity $R = p/z$, where p is the track momentum and z is the charge number. The measurement of deuterons is affected by a large background, as for all nuclei, coming from knockout from material. Rejection of this background is possible by restricting the distance-of-closest-approach (dca) of the track to the primary vertex in z-direction dca_z and then fitting the dca_{xy} distribution to extract the signal in the transverse momentum ($p_{\rm T}$) window between 0.6 and 1.9 GeV/c (technique is described in more detail in [6]). The deuterons are identified using only the specific energy loss (dE/dx) measurement in the TPC for $p_{\rm T} < 1.5$ GeV and combining the TPC and TOF information for higher $p_{\rm T}$. A sample of deuteron selected within a 3σ cut around the expected dE/dx value is initially used to build the $m^2 - m_{\rm d}^2$-distribution, where $m_{\rm d}$ is the deuteron mass and m is the mass measured with TOF using $m^2 = p^2/(\gamma^2 - 1)$. Then, this distribution is fitted in $p_{\rm T}$ intervals. The extracted yields are then efficiency and acceptance corrected and the final spectra are shown in Figure 1 for five different collision centralities. The spectra show a characteristic hardening with increasing centrality, qualitatively similar to proton spectra. To extract $p_{\rm T}$ integrated yields the spectra in the different centrality bins are fitted by individual blast-wave distributions. The ratios of these yields with those of protons are shown in Figure 2 for five different centralities. The measured ratio agrees well with the mean of the d/p and the $\bar{\rm d}/\bar{\rm p}$ from PHENIX [7], which is a fair comparison since the baryo-chemical potential μ_B at the LHC is getting close to 0 MeV [2].

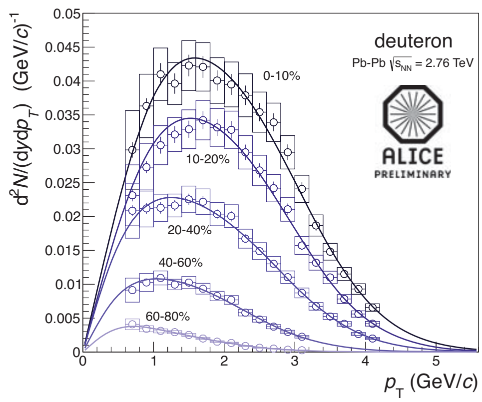

Figure 1: Measured deuteron spectra at $\sqrt{s_{\rm NN}} = 2.76$ TeV for five different centralities. The lines through the measured points are individual blast-wave fits.

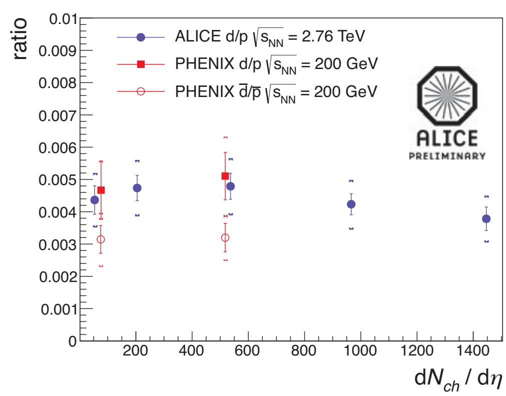

Figure 2: Deuteron-to-proton ratio over centrality compared with the PHENIX measurement [7] of deuteron-to-proton ratio and the anti-deuteron-to-anti-proton ratio at $\sqrt{s_{\rm NN}} = 200$ GeV.

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