

Vector meson production at the LHC with the ALICE detector

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Light vector meson (ρ^0 , ω , ϕ) production provides key information on the hot and dense state of strongly interacting matter produced in high-energy heavy-ion collisions. In particular, strangeness enhancement can be accessed through the measurement of ϕ meson production. Vector meson production in pp collisions provides a reference for these studies.

We analysed the vector mesons produced in the rapidity range $2.5 < y < 4$ at the ALICE experiment [1] through their decays in muons pairs. The ALICE muon spectrometer is composed of a front hadron absorber, followed by a set of tracking stations, a dipole magnet, an iron wall acting as muon filter and a trigger system formed by two stations of two resistive plate chambers (RPC). The muon trigger is fired when at least three of the four RPC planes give a signal compatible to a tracklet in the muon trigger system. It is the main trigger used in this analysis. A minimum bias trigger, two arrays of scintillators detectors ($-5.1 < \eta < -2.8$ and $1.7 < \eta < 3.7$) and on a silicon pixel detector placed in the vertex region ($|\eta| < 1.6$), was also used.

Data were collected in pp collisions at $\sqrt{s} = 7$ TeV during the 2010 LHC run.

The invariant mass spectrum for opposite sign muon pairs was measured for $1 < p_T < 5$ GeV/c. Muon pairs were selected asking that each muon track reconstructed in the tracking chambers matches the corresponding tracklet in the trigger stations. A cut on the muon rapidity $2.5 < \eta_\mu < 4$ was applied in order to remove the tracks close to the acceptance edges. The combinatorial background in the opposite sign dimuon spectrum was subtracted using an event mixing technique.

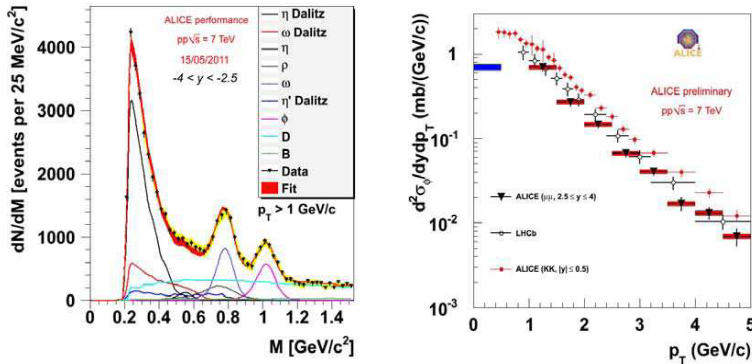
The resulting mass spectrum, shown in Fig. 1(a), was described as a superposition of light meson decays in muon pairs, with the additional contribution coming from charm and beauty semi-muonic decays. From the fit of the dimuon invariant mass spectrum, it was possible to extract the number of ϕ ($N_\phi = 3200 \pm 150$) and $\rho + \omega$ ($N_{\rho+\omega} = 6830 \pm 150$).

The cross sections were extracted from a sample corresponding to an integrated luminosity of $L_{\text{INT}} = 55.7 \text{ nb}^{-1}$, through the formula $\sigma_\phi = \frac{N_\phi^c}{BR(\phi \rightarrow \mu^+ \mu^-)} \frac{\sigma_{MB}}{N_{MB}} \frac{N_\mu^{MB}}{N_\mu^{MB}}$, where N_ϕ^c is the measured number of ϕ mesons corrected for the efficiency and acceptance, N_{MB} is the number of minimum bias collisions, $\sigma_{MB} = 62.3 \pm 0.4(\text{stat}) \pm 4.3(\text{syst}) \text{ mb}$ [2], is the minimum bias cross section in pp collisions at $\sqrt{s} = 7$ TeV, N_μ^{MB} is the number of single muons in the region $2.5 < y_\mu < 4$, $p_{T_\mu} > 1$ GeV/c collected with the

minimum bias trigger, and $N_{\mu}^{\mu-MB}$ is the number of muons in the same region collected with the muon trigger. The ϕ cross section value is $\sigma_{\phi}(1 < p_T < 5 \text{ GeV}/c, 2.5 < y < 4) = 0.940 \pm 0.084(stat.) \pm 0.095(syst.) \text{ mb}$.

The comparison with the measurements in kaon pairs performed by LHCb Collaboration in a similar rapidity range [3] and by ALICE at midrapidity [4] shows that the shapes are similar, as displayed in Fig.1(b). The rescaling of the LHCb cross section for $p_T > 1 \text{ GeV}/c$ and for $2.5 < y < 4$ gives $\sigma_{\phi} = 1.07 \pm 0.15$ (full error) mb in agreement with the ALICE measurement in the same phase space domain.

In order to extract the ω cross section, we fit the dimuon mass spectrum leaving the ρ normalization as an additional free parameter in the fit to the dimuon mass spectrum. The resulting value is $\frac{\sigma_{\rho}}{\sigma_{\omega}}(1 < p_T < 5 \text{ GeV}/c, 2.5 < y < 4) = 1.15 \pm 0.20(stat.) \pm 0.12(syst.)$. From this fit and from the measurement of the ratio $\frac{N_{\phi}}{N_{\rho+\omega}} = \frac{BR_{\phi \rightarrow \mu\mu}\sigma_{\phi}}{BR_{\rho \rightarrow \mu\mu}\sigma_{\rho} + BR_{\omega \rightarrow \mu\mu}\sigma_{\omega}}$ it was possible to extract the ratio $\frac{\sigma_{\phi}}{\sigma_{\omega}}(1 < p_T < 5 \text{ GeV}/c, 2.5 < y < 4) = 0.178 \pm 0.015(stat.) \pm 0.008(syst.)$. The ω production cross section is extracted from the ratio $N_{\phi}/(N_{\rho+\omega})$ leading to $\sigma_{\omega}(1 < p_T < 5 \text{ GeV}/c, 2.5 < y < 4) = 5.28 \pm 0.46(stat.) \pm 0.58(syst.) \text{ mb}$.



(a) Dimuon mass spectrum for $p_T > 1 \text{ GeV}/c$. (b) Differential cross section $d^2\sigma_{\phi}^2/dydp_T$ as a function of p_T .

References

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