D^0 cross section in pp collisions at $\sqrt{s} = 7$ TeV, measured with the ALICE experiment

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The measurement of the cross-section for charm production in pp collisions at the LHC is not only a fundamental reference to investigate medium properties in heavy-ion collisions, but also a key test of pQCD predictions in a new energy domain.

The ALICE [1] experiment has measured the D meson production in pp collisions at $\sqrt{s} = 7$ TeV. We present the analysis procedure for $\mathrm{D}^0 \to \mathrm{K}^-\pi^+$ and for the calculation of efficiency and acceptance corrections. Finally, we show the preliminary results on D^0 cross section in pp collisions at $\sqrt{s} = 7$ TeV, measured in the region $2 < p_\mathrm{t} < 12$ GeV/c at central rapidity $|y| < 0.5$. These results are compared to perturbative QCD predictions.

The analysis is based on an invariant mass analysis of opposite-charge pairs of reconstructed tracks that can represent a D^0 with a displaced vertex (the mean proper decay length of the D^0 is $c\tau \approx 123$ μm). The selection is based on topological cuts and particle identification via specific energy deposit and time-of-flight measurement. The cross section is calculated from the raw signal yield extracted with the invariant mass analysis, $N^{\mathrm{D}^0\ \mathrm{raw}}(p_\mathrm{t})$, using the following formula:

$$\left.\frac{\mathrm{d}\sigma^{\mathrm{D}^0}}{\mathrm{d}p_\mathrm{t}}\right|_{|y|<0.5} = \frac{1}{2}\frac{1}{2\, y_\mathrm{acc}\Delta p_\mathrm{t}}\frac{f_{prompt}\cdot N^{\mathrm{D}^0\ \mathrm{raw}}(p_\mathrm{t})\Big|_{|y|<y_\mathrm{acc}}}{\epsilon_{prompt}\cdot \mathrm{BR}\cdot L_{int}}. \quad (1)$$

Here, ϵ_{prompt} means the efficiency of prompt mesons, which accounts for selection cuts, for track and primary vertex reconstruction efficiency, and for detector acceptance. The f_{prompt} is the prompt fraction of raw yield.

Figure 1 (Left) shows the invariant mass distribution for $p_\mathrm{t} > 2$ GeV/c after applying the cuts, which corresponds to 1.1×10^8 minimum bias events collected by ALICE in 2010 at $\sqrt{s} = 7$ TeV. Figure 1 (Right) shows the efficiencies for $\mathrm{D}^0 \to \mathrm{K}^-\pi^+$ with all the decay particles in the acceptance $|\eta| < 0.9$. The efficiencies increase and flatten at about 0.1 at $p_\mathrm{t} > 2$ GeV/c. The efficiency without particle identification selection, shown for comparison, is the same as with particle identification for $p_\mathrm{t} > 2$ GeV/c, indicating that this selection is essentially fully efficient for the signal. The efficiencies for D^0 meson from B meson decay, also shown for comparison, are larger by a factor about 2, because this feed-down component is more displaced from the primary vertex, due to the longer B life time. The $10 - 15\%$ feed-down from B decays is subtracted based on pQCD prediction [2].

Several sources of systematic uncertainties were considered, namely those affecting the signal extraction from the invariant mass spectra and all the correction factors applied to obtain the p_t-differential cross sections. A summary of the estimated relative systematic errors is shown in Fig 2 (Left).

The p_t-differential cross section for prompt D^0, obtained from the yields extracted by fitting the invariant mass spectra and corrected for efficiency and B feed-down, is shown in Fig 2 (Right). The error bars represent the statistical errors, while the systematic errors are plotted as rectangle areas around the data points. The measured D^0 meson production cross section is compared to two theoretical predictions, namely FONLL [2] and GM-VFNS [3]. Our measurement of D^0 at $\sqrt{s} = 7$ TeV is reproduced by both models within their theoretical uncertainties.

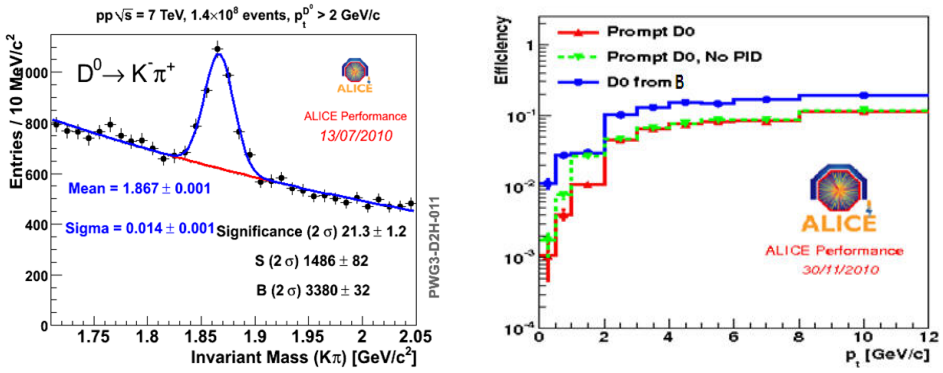

Figure 1: Left: $p_{\rm t}$ >2 GeV/c invariant mass distribution. Right: efficiencies for $\rm D^0$ as a function of $p_{\rm t}$.

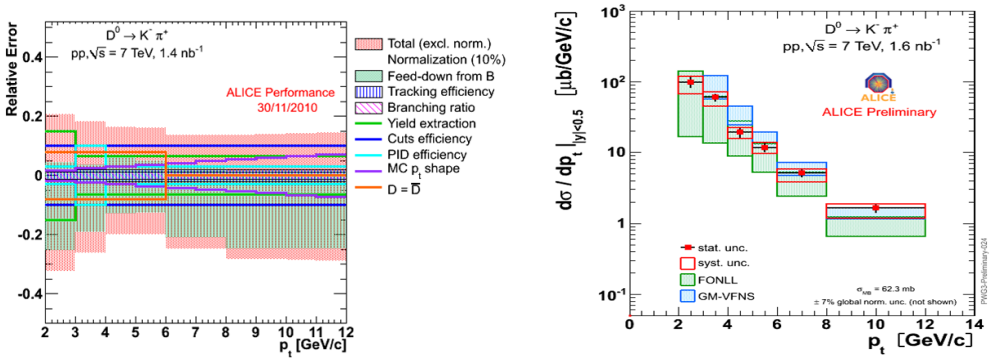

Figure 2: Left: systematic errors summary plot. Right: $p_{\rm t}$-differential cross section for prompt $\rm D^0$ in pp collisions at $\sqrt{s} = 7$ TeV compared with FONLL [2] and GM-VFNS [3] theoretical predictions.

References

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[3] B.A. Kniehl *et al.*, Phys. Rev. D77 (2008) 014011; Private communication.