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Measurement of cross section for D^0 direct production from the $K\pi\pi\pi$ decay channel in p-p collisions at $\sqrt{s} = 7$ TeV with ALICE

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Summary. — The production of the D^0 meson in pp collisions at $\sqrt{s} = 7$ TeV through its hadronic decay in $K\pi\pi\pi$, using the ALICE detector, is measured. By applying a series of topological cuts and PID selections, signal peaks in the invariant mass distribution $M(K\pi\pi\pi)$ have been found in different p_T bins, ranging from 4.5 to 25 GeV/c. After performing corrections for efficiency, acceptance and feed-down from beauty contribution, differential direct production yield and cross section can be computed and compared to pQCD theoretical predictions which show a good agreement for the shape of the p_T-differential cross section.

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1. – Motivations of the analysis

The study of direct production of heavy flavour quarks in pp collision at LHC energies is an important test of pQCD in a new energy domain. For ALICE, pQCD prediction for charm production is also an important reference for heavy ions collisions, in which heavy flavour quarks will be used as probes to study the properties of matter created in such collisions.

2. – Selection phase

The 4-prong decay channel allows to have good precision in the vertex reconstruction and provides a high branching ratio; however, the presence of four daughters produces a large combinatorial background. Thus, the selection of the candidates, constructed from the combinations of two positive and two negative tracks, requires strong topological

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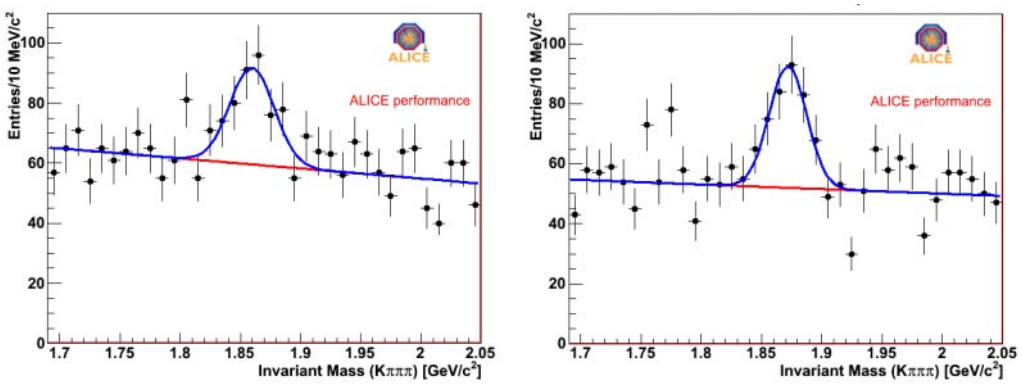

Fig. 1. – Invariant mass spectra $M(\mathrm{K}\pi\pi\pi)$ for D^0 candidates, on the left for $6 < p_\mathrm{T} < 8\,\mathrm{GeV}/c$, on the right for $p_\mathrm{T} > 8\,\mathrm{GeV}/c$. A linear plus Gaussian function is used for the fit.

and PID cuts. The excellent vertexing and PID performances of ALICE experiment are basilar in rejecting fake candidates.

Topological cuts rely on the distance covered by the D^0 before its decay ($c\tau = 123\,\mu\mathrm{m}$), and consist in DCA between opposite sign tracks, distance of D^0 vertex from primary vertex, cosine of pointing angle of candidate and invariant mass cuts for compatibility with $\rho(770)$ resonance, abundantly present in this kind of decay. These cuts are optimized for each p_T bin, by studying how the significance changes when varying the cut values and by choosing those which maximize it.

Particle identification cuts are based on the excellent PID capability of ALICE (TOF and TPC detectors are used in this analysis) and require that the four daughter of a candidate have to be at least "compatible" with a kaon and three pions. This compatibility criterium is defined as a compromise so as both background reduction and adequate statistics are obtained. In addition, information from the $\rho(770)$ compatibility cut is used to refine the PID selection process. With those cuts, the invariant mass distributions $M(\mathrm{K}\pi\pi\pi)$ show nice peaks in five p_T bins (see fig. 1). The value of the signal can be extracted by applying a linear plus Gaussian fit, since a study on Monte Carlo distribution can show that combinatorial background has basically a linear shape.

3. – Correction phase

A series of correction on the value of signal is necessary in order to evaluate the yield and the cross section. These corrections, for cut efficiencies and acceptance, have been calculated by an analysis on a charm enriched Monte Carlo set, and obtained by dividing the number of reconstructed D^0 when applying the cuts by the number of D^0 generated in the rapidity range $|y| < 0.5$. Correction for D^0 producted by feed-down of beauty has also been determined, relying on the ratio between feed-down and direct D^0 production from FONLL predictions. The p_T differential yield of the D^0 direct production has been obtained by applying corrections to the value of the signal.

The comparison of this yield, which includes statistical error and a first raw extimate of sistematic uncertainties, with FONLL theoretical prediction, after renormalizing data and predictions to the same integral, shows a good agreement for the shape of the distributions.