Abstract

The Quantum Chromo-Dynamics (QCD) theory predicts, in condition of very high temperature and/or energy density, a phase transition from the ordinary nuclear matter to a colour-deconfined medium called Quark–Gluon Plasma (QGP). The ALICE experiment was designed and optimized for the investigation of this hot and dense medium, produced via heavy-ion collisions at the Large Hadron Collider (LHC). Due to the very short lifetime of the QGP, its properties cannot be directly revealed and its characterization is done through indirect signals, obtained from the observation of the ordinary particles that emerge from the interaction region. In particular, charm quarks are effective probes used for the investigation of QGP. Due to their large masses, they are produced in hard scattering processes on a timescale shorter than the QGP formation time and therefore experience the whole system evolution. The measurement of charm-baryon production, and in particular the baryon-to-meson ratios, provides unique information to characterize novel mechanisms of hadron formation beyond in-vacuum fragmentation, e.g. coalescence, which are expected to be significant in presence of a medium characterized by free colour charges. Measurements of charm-baryon production in pp collisions are essential to establish a baseline for p-A and A-A collisions. In addition, they provide critical tests of perturbative QCD (pQCD) calculations and models of charm hadronisation in hadronic collisions.

The aim of the studies carried out in this thesis is the measurement of Λ_c^+ charmed baryon yield, employed for the estimation of the baryon-to-meson ratio Λ_c^+/D^0. The first measurements of the Λ_c^+ production yields and of the Λ_c^+/D^0 baryon-to-meson ratios as a function of the charged-particle pseudorapidity density are presented. The study allows the characterization of the evolution of the Λ_c^+/D^0 baryon-to-meson ratio from very low to high charged particle density and provides new experimental constraints on the production mechanisms in pp collisions. The analysed sample is collected in pp collisions at the energy in the centre-of-mass system of $\sqrt{s} = 13$ TeV with the ALICE detector. The measurement is performed by reconstructing the hadronic decay channel $\Lambda_c^+ \to \mathrm{pK}_s^0 \to \mathrm{p}\pi^+\pi^-$, exploiting selections on its decay topology and on the particle identification (PID) of the decay products, extracting the signal via an invariant mass analysis and correcting for its selection and reconstruction efficiency and for the detector acceptance. A machine

learning algorithm based on Boosted Decision Trees (BDT) has been developed and is used in order to improve the signal extraction by optimally combining topological and PID variables that allow discriminating signal candidates from the combinatorial background. The results are compared with a theoretical model that explains the multiplicity dependence by a canonical treatment of quantum charges in the statistical hadronisation approach and with predictions from `PYTHIA` event generators that implement colour reconnection mechanisms beyond the leading colour approximation to model the hadronisation process.