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Production of Σ baryons as a function of multiplicity in pp collisions at the LHC with ALICE

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The strangeness content of the final state in ultrarelativistic heavy ion collisions has been studied through measurements of kaons, Λ, Ξ and Ω baryons in pp, pA and AA collisions. Σ baryons contain a single strange quark and form a triplet, with the charge (+, 0, -) depending on the light quark content. In a thermal model scenario, these states are abundant enough to carry a significant fraction of the strangeness produced in the collision. However, the experimental measurement is challenging, and to date only Σ^0 in 7 TeV pp collisions have been measured by ALICE, while few other experiments have measured the charged states at lower pp(pp) collision energies.

A number of methods to identify charged Σ have been developed by ALICE during the LHC Run 2. The decay $\Sigma^+ \to$ p π^0 can be reconstructed via the direct detection of the proton and the two gammas from the π^0 decay, either through double conversion into e^+e^- pairs or through one converting and the other being reconstructed in the Photon Spectrometer (PHOS). Additionally, a method to detect anti-neutrons in the PHOS has been developed, allowing the $(anti - \Sigma)^\pm \to$ anti-n + $\pi^\pm$ decays to be reconstructed. We present the transverse momentum spectra of Σ^+ and its charge conjugate anti-particle, in both minimum bias and high-multiplicity triggered pp collisions at $\sqrt{s} = 13$ TeV. These are then compared to the latest MC simulations, including different PYTHIA tunings, which best reproduce the existing hyperon data.

With the advent of Run 3, ALICE has improved the capability of the Inner Tracker, allowing the detection of the charged Σ particle with the reconstruction of its decay after traversing several detector layers. The performance of this novel reconstruction method is discussed. In addition, the prospects for measurements of the interaction between Σ and other baryon species will be discussed together with the implications for constraining the neutron star equation of state.

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