Measurement of integrated yields of light-flavour hadrons, resonances and (hyper-)nuclei at LHC energies with the ALICE experiment and their description with thermal models

ALICE [1] is a general-purpose heavy-ion experiment at the CERN LHC aimed at studying the physics of strongly-interacting matter and the quark–gluon plasma. A unique detector design has been adopted to fulfill tracking and particle-identification requirements. Thanks to these features the experiment is able to identify hadrons in a wide momentum range by combining different detecting systems and techniques: specific energy loss in silicon and gas, time-of-flight, transition and Cherenkov radiation, calorimetry, muon filters and topological decay reconstruction [2].

ALICE has measured the $p_t$-integrated production yields of primary light-flavoured hadrons, resonances and (anti)hyper(nuclei) in a wide momentum range and in several colliding systems. Primary hadrons are defined as prompt particles produced in the collision and all decay products, except products from weak decay of strange particles. The measurements have been performed in proton-proton collisions at several centre-of-mass energies (900 GeV, 2.76 TeV and 7 TeV), in $p$-Pb collisions at 5.02 TeV in different multiplicity classes and in Pb-Pb collisions at 2.76 in different centrality classes. The data are fitted and extrapolated outside the measured $p_t$ and the integrated production yields $dN/dy$ are obtained using the measured data points and the extrapolation.

The $p_t$ distributions of particles and antiparticles as well as the integrated production yields are compatible within uncertainties at LHC energies. Therefore, whenever both particle and antiparticle measurements are available, average yields are computed and reported in the following particle ratios. Particle ratios measured in pp collisions show no significant energy dependence at the LHC. On the other hand, particle ratios evolve as a function of the system size, passing from small (pp), intermediate (p-Pb) to large (Pb-Pb) collisions system. Strangeness and deuteron enhancement is observed as well as $K^*$ and baryon suppression.

The $p_t$-integrated yields and ratios can be interpreted in terms of statistical (thermal) models. The success of these models in describing the ratios of hadron yields produced in nucleus–nucleus collisions is remarkable, having been employed to describe AGS, SPS and RHIC data. From thermal model fits, one can extract the thermal properties of the system at the moment when the particle abundances are fixed, the key parameters being the “chemical freeze-out” temperature $T$, and the baryochemical potential $\mu_B$ (the latter is consistent with and therefore assumed to be zero, being particle/antiparticle production compatible). A comparison of three statistical hadronization models, THERMUS 2.3 [3], GSI [4] and SHARE 3 [5] whose parameters temperature (T) and volume (V) are fitted to the data. The best fit yields very similar parameters and reveals a possible anomalous suppression of proton yields in central Pb-Pb collisions at the LHC.