Abstract

In this thesis, a study is presented of the possible thermalisation of the medium created in relativistic heavy-ion collisions using the scheme involving light front variables. Simulated events at RHIC energies and ALICE experimental data at the LHC energies from the Large Hadron Collider are used for this analysis. An introduction to the concepts regarding a quark-gluon deconfined medium is given and the experimental attempts to create such a system in the laboratory in heavy-ion collisions are described. The concept of temperature and the signatures of the existence of a system which has reached thermal equilibrium in such collisions are discussed. A detailed description of the light front analysis, the methods and geometrical aspects involved in our study are presented. UrQMD, EPOS and HIJING models were used to simulate the heavy-ion collisions at various energies and the light front scheme was applied on a phenomenological level as a preliminary step towards the analysis of the LHC data. The analysis scheme could separate the particles in the phase space into two groups. It is shown that the distributions of square of the transverse momentum, the polar angle and the light front variable of particles belonging to one among these two groups can be described with the Boltzmannian form for their energy distribution parameterised by the same, within the errors, value of the mass-dependent temperature irrespective of the particle species studied and the available centre of mass-energy of the collisions. The analysis has been carried out for $\pi^{\pm}$, $K^{\pm}$, $p(\bar{p})$, η^0, the hyperons Λ, Σ, and Ξ from Au-Au UrQMD collisions at $\sqrt{s} = 200$ GeV, for $\pi^{\pm}$, $K^{\pm}$ and $p(\bar{p})$ from Au-Au EPOS collisions at $\sqrt{s} = 200$ GeV, and for $\pi^{\pm}$, $K^{\pm}$ and $p(\bar{p})$ from Pb-Pb HIJING collisions at $\sqrt{s} = 2.76$ TeV. This enables us to think that a possible thermalisation has been reached in the medium from which these particles are emitted. The HIJING model was also used to demonstrate that the light front analysis is feasible even when we have kinematic cuts on pseudorapidity and transverse momentum owing to the specifications of the experimental setups. The details of the ALICE apparatus at point 2 of the Large Hadron Collider are given followed by the presentation of the light front analysis of Pb-Pb collisions at $\sqrt{s} = 2.76$ TeV from the ALICE experiment. The identified particle species namely $\pi^{\pm}$, $K^{\pm}$, $p(\bar{p})$ and deuterons from Pb-Pb collisions at various centralities were used to perform the light front analysis and we could always find a group of particles which follows the Boltzmann statistics. This impels us to think that for the so selected group of particles a thermalisation has been reached in the heavy-ion collisions in ALICE experiment at LHC.