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Studies of net-charge fluctuations and balance functions with the ALICE detector at the LHC

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The creation of a strongly interacting deconfined Quark Gluon Plasma (QGP) phase in relativistic heavy-ion collisions can be studied by the fluctuations of conserved quantities like net-charge, and correlations between positive and negative pairs by using the method of Balance functions. Net-charge fluctuations are sensitive to the number of charges present in the system, thus the fluctuations in the QGP, with fractionally charged partons, are expected to be different from those of the hadron gas with unit charged particles. Lattice calculations suggest that the higher moments of net-charge distributions and their products are sensitive to the correlation length, and are related to the thermodynamic susceptibilities of the system. The method of the Balance function, on the other hand, is sensitive to collective flow and the breakup temperature and was proposed to give a handle on the hadronization time. A combined study of net-charge fluctuations with Balance functions provides insight to the properties of matter created in high energy collisions. We will present the first results of net-charge fluctuations, higher moments of net-charge distributions and Balance functions for Pb-Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV measured by the ALICE experiment at the LHC. The results from net-charge fluctuations, presented in terms of v_{dyn} and D-measure, are compared to predictions for a system initially dominated by a QGP, as well as for a hadron resonance gas. The widths of the Balance functions in pseudorapidity and azimuthal angle for non-identified charged particles show a clear centrality dependence, consistent with the picture of a delayed hadronization but also with a system exhibiting larger radial expansion in central collisions. A comparison of the results will be made to lower energy collisions at SPS and RHIC as well as to several models that incorporate collective effects.

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