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Soft pion production signals of new phenomena at the LHC

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The LHC data on hadron production, transverse-momentum spectra, and particle correlations in Pb+Pb collisions demonstrate a peculiar behavior [1,2], which can be interpreted as a coherent emission of pions with low momenta [2-5]. It can be a consequence of the prior gluon condensation [6,7], or the overcooling of the quark-qluon plasma deeply into the hadronic phase [8]. In both cases a possible consequence is the formation of the Bose-Einstein condensate (BEC) of pions at the freeze-out. The presence of the condensate decreases the non-equilibrium parameters [5], and therefore improves the agreement of the non-equilibrium thermal model with the data for heavy nuclei. The combined analysis of the hadronic multiplicities and the pion transverse momentum spectra indicates that about 5% of pions at each centrality of the collision could be in the condensate [5]. The data on two- and three-pion correlations support even larger coherent fraction of 23% [2]. This could be the consequence of the fact that correlations are much more sensitive observables [9]. The correlated pions have a momentum below 150-200 MeV [5,8]. It is on the edge of the current acceptance range of the LHC [1,8]. Therefore some efforts are required in order to clarify whether the BEC of pions is reached. However, if the BEC of pions is formed, then its temperature is 10^{10} times higher than the temperature of the famous BEC of ultra-cold atoms. There are also much higher densities, smaller volumes and different interaction forces involved. The studies of the properties of the high temperature pion condensate could open a wide new field of research, similar to the studies of the BEC of ultra-cold atoms. This talk is proposed to bring the attention of the heavy-ion community to this interesting and promising opportunity.

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