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Bose–Einstein correlations and pion lasers in strong interaction processes

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A multi-particle Bose–Einstein symmetrization can enhance the emission of pions and as consequence can lead to the creation of pion lasers in strong interactions at high energies. Onset of the Bose–Einstein condensation is driven by the critical space density of charged secondary bosons which are mostly pions. The energy dependence of space pion density at freeze-out and its critical value, calculated from estimations for volume of emission region and for total multiplicity, is investigated for both the proton-proton and the nucleus-nucleus collisions. The space-time extent of emission region is derived with the help of Bose–Einstein correlations of pion pairs produced in various collisions within the framework of three dimensional Gaussian model for the source. It is shown that the space density of charged particles is smaller than its critical value and Bose–Einstein condensation cannot be expected for secondary pions in proton-proton collisions at energies up to about 100 TeV or even higher. A marked enhancement is observed for charged pion density in heavy ion collisions with respect to the proton-proton ones at similar collision energies. Relation between the charged particle density and its critical value allow the possibility of lasing behavior for secondary pions in nucleus-nucleus collisions in multi-TeV energy domain.

Primary author(s) : Prof. OKOROKOV, Vitalii (National Research Nuclear University ”MEPhI”)

Presenter(s) : Prof. OKOROKOV, Vitalii (National Research Nuclear University ”MEPhI”)

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