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Probing the String Clustering Model in pp interactions at LHC energies

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Multiple particle production in pp interactions at LHC energies is considered in a model with quark-gluon strings (color flux tubes) as sources, assuming the string cluster formation. Within this model multiplicity distributions of charged particles, their combinants and the properties of the strongly intense variable Σ, which characterizes the correlations between the number of particles in two observation windows separated in rapidity, are studied. We use a Regge-like quasi-eikonal approach to find the distribution of strings in the transverse plane of pp-collision. This allows us to take into account string fusion processes leading to the formation of string clusters using a finite lattice (grid) in the impact parameter plane. Analytical calculations supplemented by MC simulation, make it possible to find the multiplicity distributions and corresponding combinants as well as the dependences of the variable Σ both on the width of the observation windows and on the size of the gap between them for different initial energy and centrality of pp collisions.

We show that in pp collisions at LHC energies, string fusion effects leading to the formation of string clusters have a significant effect on the behavior of considered observables. We see that the so-called modified combinants found from the calculated multiplicity distributions are indeed very sensitive to the shape of the multiplicity distribution spectra, and that our string clustering model reproduces the general experimental behavior of the combinants obtained from ALICE and CMS data, in particular, their oscillations.

We also demonstrate that the experimentally observed dependence of the strongly intensive variable Σ on the initial energy and centrality of pp collisions can be explained only in the presence of sources of different types, the role of which in our model is played by single strings and clusters formed by the fusion of several strings. It is also shown that a comparison of the results of our model with the preliminary experimental data of ALICE makes it possible to extract the parameters of clusters with different numbers of merged strings, in particular, to find their two-particle correlation functions.

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