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Cumulative production at central rapidities due to interactions involving fluctons

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We study the yields of pions and protons with large transverse momenta at mid-rapidities in the region that is kinematically inaccessible for single nucleon-nucleon interactions (the so-called cumulative region), which may be observed in nuclear collisions by MPD and SPD detectors of the NICA complex. We assume that particles in this kinematic region are formed as a result of scattering from the so-called nuclear "fluctons" , which from a modern point of view can be considered as clusters of cold quark-gluon matter with a high baryon density. We generalize the microscopic quark-parton approach developed in [1-4] for describing the production of cumulative particles in the fragmentation region of one of the colliding nuclei to the case of particle production in this new cumulative region.

For the case of nucleon-flucton interaction, we found that there is a change in the ratio of the proton to pion yield in the region of central rapidities and high transverse momenta compared to the cumulative production in the fragmentation region of one of the nuclei. The reason for this is that in the case of cumulative proton production, the mechanism of coherent coalescence (recombination) of three flucton quarks into a proton dominates, while in the case of cumulative pion production, the fragmentation of a single flucton quark into a pion dominates [3,4,9]. We compare the obtained theoretical results with the results of our preliminary estimates of particle yields in this region based on a more phenomenological approach [5-7].

We show that the study of cumulative phenomena in this new region of central rapidities and large transverse momenta also opens up the possibility of experimentally studying a new interesting process of flucton-flucton interaction in MPD and SPD experiments at NICA, which cannot be studied in the region of fragmentation of one of the nuclei. Note that the study of this process in dd collisions at future NICA SPD has some advantages over MPD. There is no contribution from additional nucleon-nucleon collisions when both deuterons are in the state of 6-quark bags at the moment of collision. This reduces the background and simplifies the registration of a cumulative particle in correlation with particles formed from fragmentation of a flucton residue [8]. An important role in recording rare cumulative processes is also played by the much higher frequency of collisions that the SPD installation can record compared to the MPD.

It is important that studies of particle production in this new cumulative region are available for experimental study only at relatively low initial energies of colliding nuclei of the NICA collider facility and are not available for experimental study at the RHIC and LHC colliders.

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Section

Heavy ion collisions at Intermediate and high energies

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