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Cumulative production of pions by heavy baryonic resonances in proton-nucleus collisions

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Pion production in the backward direction in the target rest frame is considered in proton-nucleus (p+A) collisions. Pions outside the kinematical boundary of proton-nucleon (p+N) collisions, the so called cumulative effect, is studied. Basic restrictions on the energy of pions emitted in the backward direction in p+N and p+A reactions are considered. These are restrictions that follow from energy-momentum conservation. It is argued that resonances with very high masses are the only source of the cumulative pions. The resonances are first created in p+N reactions. Due to successive collisions with nuclear nucleons, the masses of these resonances may increase and simultaneously their longitudinal velocities decrease. It is suggested that these two effects give an explanation of the cumulative pion production. The heavy hadron-like systems with very high masses (heavy resonances, Hagedorn fireballs, quark-gluon bags, baryon and meson strings) are of primary importance for properties of strongly interacting matter at high temperatures and/or baryonic density. They may have also decisive influence on the transition between hadron matter and quark-gluon plasma, and define the type of this phase transition and existence of the QCD critical point itself. We also use the Ultra relativistic Quantum Molecular Dynamics model to describe the existing data and analyze some microscopic aspects of cumulative pion production in p+A reactions.

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