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Fractal dimensions of nucleon, nuclei and pion

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A brief review of the z-scaling concept for the analysis of hadron production over a wide range of hadron and nuclear collision energies is given. The concept is based on the fundamental principles of self-similarity, locality, and the fractality of hadron interactions. The notion of the fractal dimension of hadrons and nuclei, which is an important ingredient of the z-scaling concept, is discussed in the context of searching for new physics at small scales. In the z-scaling approach, the hadron spectrum is described by the scaling function $\Psi(z)$ as a function of the self-similarity variable z . This variable is expressed via the momentum fractions of colliding particles and scattered constituents fragmented to produce inclusive particles, the structural and fragmentation fractal dimensions, the multiplicity density of negative particles, and a model parameter interpreted as the specific heat of the produced medium. Properties of $\Psi(z)$ including its energy, angular, multiplicity, and flavor independence, are discussed. The shape of the scaling function reveals a power law at low and high z . A microscopic scenario of hadron production in terms of fractalons was given. The z-scaling scheme is used to study the dependence of momentum fractions and recoil mass on the collision energy, transverse momentum, and mass of the produced inclusive particle.

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