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SOLITON SOLUTIONS OF HYDRODYNAMIC EQUATIONS IN DESCRIBING COLLISIONS AND OSCILLATIONS OF ATOMIC NUCLEI

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In the present work, the hydrodynamic approach is used and the distribution function of particles in complex systems is found. Within the framework of our approach, we have found an analytical solution of the equations of hydrodynamics in the soliton approximation for the collision of layers in the one-dimensional and two-dimensional cases. The prospects of the hydrodynamic approach in physics and the importance of taking into account nonequilibrium processes are noted. The compression stage, the expansion stage, and the freeze-out stage are considered within the framework of a single formula for layers with energies on the order of ten MeV per nucleon. Such a reduction of solutions of hydrodynamic equations to soliton solutions has not been considered before.

The introduction of dispersion into the effective forces and into the pressure does not violate the concept of the formation of a hot spot. The introduction of additional dimensions does not violate this representation. Usually the solution of this system of non-linear partial differential equations is found numerically on a computer. Here we develop an approach to the approximate analytical solution of these equations, both in the case of weak nonlinearity, by reducing them to the Korteweg-de Vries equations, and in the case of large-amplitude perturbations, using soliton-like solutions. Our generalization to the two-dimensional case leads to the idea of the formation of a rarefied bubble region at the stage of expansion. And the approach itself is of independent interest and can be used in other areas of physics when calculating the nonlinear dynamics of oscillations of complex systems. In our works [1-4], it was shown that the local thermodynamic equilibrium in the process of collisions of heavy ions is not established immediately. For this purpose, in this work, we use the result of solving the kinetic equation to find the nucleon distribution function, which at low energies leads to the equations of nonequilibrium long-range hydrodynamics [1]. The non-equilibrium approach to hydrodynamic equations makes it possible to describe experimental data better than the equation of state corresponding to traditional hydrodynamics, which assumes the establishment of local thermodynamic equilibrium.

1. A.T. D'yachenko, K.A. Gridnev, and W. Greiner, J. Phys. G40, 085101 (2013).
2. A.T. D'yachenko, I.A. Mitropolsky, Phys. Atom. Nucl. 83, 558 (2020).
3. A.T. D'yachenko, I.A Mitropolsky , Bull. Russ. Acad. Sci. Phys. 84, 391 (2020).
4. A.T. D'yachenko, I.A. Mitropolsky, Bull. Russ. Acad.Sci. Phys. 85 , 554 (2021).

The speaker is a student or young scientist

No

Section

1. Experimental and theoretical studies of nuclear reactions

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