Nonlinear Phenomena And Transport In Non-Ideal Charged And Neutral Systems

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The nonlinear response theory approaches are developed to study the nonlinear phenomena for charged dense matter and nonlinear transport in non-ideal charged and neutral systems.

The nonlinear phenomena: plasma wave echo and waves transformation have been investigated under non-ideal Coulomb system conditions based on a variant of the nonlinear response theory. Some general restrictions on the values of quadratic response functions are considered. The model for the determination of quadratic response functions is presented. The conditions for experimental realization of the mentioned phenomena in non-ideal plasma are examined. It is shown that ultra-short field pulses can induce the phenomena. Other nonlinear phenomena in non-ideal charged matter can be considered in the offered way. The studying of frequency moments and corresponding explicit approximations of response functions, described nonlinear phenomena, would be performed in these cases.

The theory of non-linear transport is elaborated to determine the Burnett kinetic coefficients of non-ideal multi-element matter. The Mori's algorithm is used to derive the equations of motion of dynamical value operators in the form of the generalized nonlinear Langevin equations (GNLE) for a non-ideal system. The procedure of the comparison of the phenomenological conservation equations of a continuous charged (and neutral) medium and GNLE for corresponding dynamical variables is used for the definition of Burnett coefficients. In consequence, the expressions of kinetic coefficients have been found through the long-wavelength and low frequency limits of correlation functions. These expressions of coefficients correspond to responses on second order thermal disturbances (temperature, mass velocity, etc). The method for calculation of Burnett kinetic coefficients is developed. This method is based on the investigations of long-wavelength limits of correlation functions which determine the coefficients. Corresponding kinetic equations are used for the determinations of long-wavelength limits of correlation functions. The calculations of coefficients have been provided for a model system. It is important also provide the calculation of Burnett kinetic coefficients of non-ideal matter by computer modeling to get a comparison of analytical and numerical approaches.

Thus the report shows the difference and similarity between the variants of non-linear response theory on mechanical and thermal disturbances: the description of nonlinear phenomena and nonlinear transport in non-ideal charged matter[1].

The properties of the matrix of coefficients at highest derivatives in the set of conservation equations in the linearized Burnett approximation are discussed to establish a link between the results of the Burnett coefficients investigations and hydrodynamic problems. For this purpose the traditional and Burnett models of heat and mass transfer were also considered in a two elements medium with spatial heat production which is proportional to concentration of one of the elements. Investigation of the models was provided using computational multi-parameter nonlinear analysis and analytical methods. Characteristics of thermal regimes of the models were studied and compared. The comparison shows quality difference between heat regimes of the models. Results of thermal regimes modeling can be used for example in modern energetic apparatuses development[2].

[1]. Pavlov G.A. *Technical Physics* **53**, No 6, P. 697-706 (2008)
[2]. Pavlov G.A. and Troshchiev Yu.V. *Int. J. of Heat and Mass Transfer* **62**, P.661–667 (2013)