MAIN RESULTS OF ACADEMICIAN N.N. BOGOLYUBOV IN NONLINEAR MECHANICS (Kyiv period)

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A brief revew of reseaches of N.N. Bogolyubov in nonlinear mechanics and mathematics during the Kyiv period is given.

BOGOLYUBOV CONTRIBUTION TO THE QUANTUM FIELD THEORY

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The contribution of N.N.Bogolyubov to the development of quantum field theory, and, in part, to the solution of the problem of infinities in this theory, is considered.

N.N. BOGOLUBOV WOULD BE PLEASED OF HIS FATHER COMMEMORATION

M.N. Bogolyubov

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Memories of M.N. Bogolyubov, academician of Russian Acad. of Sci., Professor of Eastern faculty of St.-Petersbourg University, brother of academician N.N. Bogolyubov.

EXACTLY SOLVABLE MODEL WITH POSITIVE FOUR-FEVMION INTERACTION

N. N. Bogolyubov (jr.), E. N. Bogolyubova

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We present the asymptotic exact solution of a model with four-fermion pair repulsive interaction at arbitrary temperatures.

KINETIC THEORY OF COLLOIDAL AND DUSTY PLASMAS

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We consider the influence of hydrodynamic interactions on transport processes in dense colloidal systems, fluidlike and crystals, longitudinal and transverse waves in colloidal crystals on basis of kinetic and semi-phenomenological theory, the construction of kinetic equations for fluidlike dusty plasmas including the charging process and the indirect forces between dust particles, such as the 'bombarding" force, the influence of charging processes on waves in dusty plasmas on the basis of kinetic theory. The theoretical results are compared with experimental data.

ANALYTICAL SOLUTION OF A REACTION-DIFFUSION PROBLEM IN CHEMICAL PHYSICS

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A set of reaction-diffusion equations, occurring in rapid surface reactions due to first-order transitions, is investigated in the case where surface restructuring is not taken into account. Chemical waves then arise in two regions A and B, separated by a common boundary which moves with the same velocity. An exact solution for the wave profile (a shock wave) is found in the B domain in terms of the still unknown velocity if the diffusion of particles is neglected. In the A domain, we propose a travelling wave solution in the form of an exponential power series. Taking into account the specific boundary conditions, we are able to determine the shock wave profile and its velocity by determining the unknown quantities through the Newton ¯ Raphson technique. As a result, analytical expressions are found between the relative pressure (ratio of the A and B pressure) and the velocity and the width of the chemical wave. These results are in agreement with numerical calculations.

A MULTIDENSITY INTEGRAL EQUATION APPROACH TO THE THEORY OF COMPLEX FLUIDS: A NEW APPLICATION TO IONIC SYSTEMS

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The possibility of a multidensity integral equation approach to the theory of complex fluids is demonstrated for ionic systems. An analytic solution in the mean spherical approximation for the model of symmetric charged hard spheres with two different types of association is obtained. One of them is connected with creation of ionic pairs and, due to the second type of association of ionic pairs, can create ionic chains with more weak strength. The solution is given in terms of the parameter J_0 defining the electrostatic part of the chemical potential and the fractions α and γ of both types of associations.

PHASE STRUCTURE IN THE OVERCRITICAL REGION AND THE PROBLEM OF LIQUID VITRIFICATION

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The heterophase structure in the vicinity of the end point on the phase coexisting curve is examined within the droplet approach as well as within the model of interpercolating heterophase states. It is shown that, in

droplet models, no phase separation and heterophase fluctuations are possible in the overcritical region. The model of interpercolating heterophase states gives a different result: with a positive but restricted from above interfacial free energy (the criterium is formulated) the phase coexisting and separation exist in the overcritical region. With changing pressure, P, and temperature, T, along a way going around the end point, the mesoscopic heterophase structure of the system changes continuously from almost pure one phase to almost pure another phase without phase transitions. Therefore, when a system evolves in the overcritical region, the continuous phase transformation takes place. The liquid-to-glass transition is the process of supercooled liquid solidification. Huge density fluctuations are (f the glass forming liquids above the glass transition temperature without phase transitions. They are identified as heterophase fluctuations. The process of glass formation has a natural description as the process of continuous phase transformation.

SELF-CONSISTENT DESCRIPTION OF THE CRITICAL BEHAVIOUR OF THREE-DIMENSIONAL ISING-LIKE SYSTEMS: THE PHASE TRANSITION TEMPERATURE AS A FUNCTION OF MICROSCOPIC PARAMETERS

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Within the framework of a consistent approach to a description of critical properties of a three-dimensional Ising system, we obtain and solve an equation for the transition temperature. We study the dependence of the critical temperature on a relation between microscopic parameters of the system (the radius of the exponentially decreasing potential of an interparticle interaction and the constant of a simple cubic lattice).

KINETIC AND DISSIPATIVE EFFECTS IN NONLINEAR MODEL SYSTEMS

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Kinetic properties of solitons with interaction between themselves and impurities are considered.

SPONTANEOUS SYMMETRY BREAKING IN THE MODELS WITH HIGHER DERIVATIVES

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The hidden symmetries of field physical systems at critical points (the points, where the absolute minimum of the thermodynamical potential Φ of a system transforms into its maximum), including the symmetries generated by the contribution of higher variations $\delta\Phi = \delta^2\Phi = \delta(\delta^2\Phi) = \ldots = 0$, are discussed. The contribution of the hidden symmetries to the peculiarities of critical behaviour of the field models is considered. It is noted that the most important properties of the Ginzburg – Landau – Wilson model, namely, the presence of a critical dimension d_c and the renormalizability which provides the efficiency of its renorm-group description, are the consequences of the conformal invariance of variational equations for the fields of order parameter. The symmetry nature of exact soliton solutions in the field models of a d-dimensional nonlinear medium is discussed.

FLUCTUATIONAL DYNAMICS AND THE STRUCTURE FACTOR OF NONLINEAR REACTIVE SYSTEMS ON A 1D LATTICE

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Restricting space to low dimensions can cause deviations from the mean-field behavior in certain statistical systems. We investigate, analytically, the behavior of the chemical reaction $A + 2X \leftrightarrow 3X$ in one dimension. We produce exact results showing that the trimolecular reaction system stabilizes in a nonequilibrium, locally frozen, asymptotic state in which the ratio r of A to X particles is a constant number, $r = 0.38$, quite different from the mean-field (MF) ratio, $r_{MF} = 1$. In contrast, the bimolecular chemical reaction $A + X \leftrightarrow 2X$ is shown to agree with the mean-field predictions.

LAGRANGE AND HAMILTON FORMALISMS FOR POINT PARTICLES WITH INTERNAL DEGREES OF FREEDOM IN EXTERNAL FIELDS

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In the present work, the Lagrange and Hamilton formalisms for particles possessing electric charge and magnetic dipole moment and for 'colored“ quarks in non-Abelian gauge fields are constructed. Poisson brackets for fundamental dynamic variables are obtained, and the quantization of motion equations is performed. The Dirac equation in the form of Feynman and Gell-Mann for charged magnetic dipoles is obtained as a result of the quantization as well as the Klein – Gordon equation for 'colored“ quarks which is invariant over local transformations of the $SU(n)$ group. The derivation of classic relativistic motion equations for particles in electromagnetic, gravitational, and $SU(n)$ non-Abelian external fields is made proceeding from the Feynman and Gell-Mann equations.

NONLINEAR GAUSSIAN TRANSFORMATION

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A nonlinear generalization of the Gaussian transformation on the set of entire functions, defined on a separable Hilbert space, is introduced. The analytic properties of this transformation are described and a set of its fixed points is found.

LIGHT QUARKS BEYOND CHIRAL LIMIT

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We discuss the instanton vacuum based Diakonov ¯ Petrov (DP) QCD effective action and propose the improved effective action, which is derived on the basis of the Lee ¯ Bardeen results for the quark determinant in an instanton field. The improved effective action (in contrast to the DP action) provides a proper account of current quark masses, which is particularly important for strange quarks. This action is successfully tested by the calculations of the quark condensate, masses of the pseudoscalar meson octet, and by axial-anomaly low-energy theorems.

SPECIFIC INTERMEDIATE-RANGE BEHAVIOUR OF THE INTERACTION BETWEEN A LIGHT CHARGED PARTICLE AND A TWO-FRAGMENT SYSTEM

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On the basis of the three-body formalism and the Watson ¯ Feshbach definition of the effective (optical) potential, the polarization potential of the interaction between a light charged particle and a two-body complex composed of charged and neutral particles is investigated in a range of distances exceeding the size of the complex but bounded from above. In an explicit analytic form, it is first derived the expressions for the polarization potential in the above range (in both the momentum and configuration spaces), that have a specific non-local behaviour in all partial states. The form of the polarization potential in the intermediate range is turned out to be determined by only the external Coulomb pair interaction and not to depend on the shape of the internal short-range pair interaction.

PECTULIARITIES OF THE STRUCTURE OF FEW-NUCLEON SYSTEMS IN THE GAUSSIAN REPRESENTATION

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Precise calculations of wave functions, density distributions, formfactors, and pair correlation functions of few-nucleon systems are carried out for some central *NN*-potentials using variational functions in the Gaussian basis representation. Specific properties and the structure of the ground and excited states of three and four nucleons are analyzed in the spinless approximation.