

International conference "Renormgroup-86"

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At the end of August 1986 an international conference "Renormgroup-86" took place in Dubna. It was devoted to different applications of the ideas and techniques of the renormgroup method in different areas of theoretical physics. The Joint Institute for Nuclear Research was the organizer of the conference. Forty reports were presented on quantum field theory, the theory of critical phenomenon, turbulence in plasma, the theory of dynamic systems, percolation, polymers, and astrophysics. All these fields of physics that are far removed from each other were unified by the use of a common method of investigation—the method of the renormalization group. This conference pursued the aim of bringing together specialists from different fields of theoretical physics who use the method of the renormgroup in their work.

In the introductory paper "Renormgroup in modern physics" D. V. Shirkov using the apparatus of functional equations and the concepts of functional self-similarity developed a common point of view on different variants of utilizing and different formulations of the renormalization group which are encountered in fields of present-day theoretical physics that are distant from each other. Yu. M. Makeenko reviewed the applications of the renormgroup in lattice gauge theories known as the "Monte-Carlo-renormgroup" and gave a resumé of the results obtained with its aid. In his report "Application of the reduction method" W. Zimmerman (München, FRG) examined the applications of the renormgroup method to models of strong and electroweak interactions with the idea of reducing them to a theory with a single coupling constant. The report by K. G. Chetyrkin was devoted to the present-day methods of analytic calculation of renormgroup functions in quantum field theory. Particular attention was paid to the application of the renormgroup approach to the investigation of the structure of nonleading terms of appropriate expansions that are proportional to masses. In their original communication G. P. Korchemskii and A. V. Radyushkin discussed the problem of determining the infrared asymptotic behavior of hard processes and perturbative QCD on the basis of utilizing the renormgroup properties of contour averages. K. Siebold (München, FRG) proved a theorem of nonrenormalization for chiral anomalies and discussed its applications. D. Ross (CERN) in his communication "The renormalization group in the presence of instantons" gave an explicit form of the renorm-invariant amplitude for the vacuum transition in the two-loop approximation for the usual and ($N = 1$)-supersymmetric gauge theories. At a session of the section on quantum field theory the following reports were also presented: "The renormgroup scenario of the unification of interactions and finite quantum field theory" by D. I. Kazakov, "Scheme-invariant perturbation theory—a new approach" by S. I. Maksimov, "A 4-loop calculation of the renormgroup β -function in QCD" by A. L.

Kataev, "Infrared asymptotic freedom in QED" by V. A. Malyshev, and "Renormgroup analysis of the three-dimensional scalar field model" by A. I. Bugrii.

The review paper by S. S. Moiseev, A. V. Tur, and V. V. Yanovskii "Scaling in strong turbulence and kinetics" discussed results associated with Kolmogorov scaling and the deviations from it in the theory of strong turbulence. The paper of A. N. Vasil'ev "Quantum renormgroup in the theory of turbulence and magnetic hydrodynamics" summarizes results of new work on the application of quantum field theory technique and the method of the renormgroup to the theory of developed turbulence. R. N. Sudan (New York, USA) told about using renormalized equations for the analysis of problems of low-frequency plasma turbulence. Papers were also presented by: M. I. Rabinovich—"Renormgroup description of spatial development of turbulence," V. N. Shtern—"Elementary renormgroup model of turbulent heat exchange" and V. S. L'vov—"Scale-invariant formulation of the theory of strong hydrodynamic turbulence."

A discussion of the problems of dynamic chaos began with the paper by V. V. Chirikov and D.L. Shepelyanskiĭ "The boundary of chaos and statistical anomalies," in which a review was given of the well-known series of papers of these authors on the investigation of the structure of motion at the boundary of chaos in phase space and on renorm-chaos. Ya. G. Sinaĭ and K. M. Khanin in their paper "The method of the renormalization group in the theory of dynamic systems" summarized the results of investigating bifurcations of the breaking down of invariant curves of the Kolmogorov-Arnol'd-Mozer theory for standard imaging. The communication of A. S. Pikovskii *et al.* "Universalities and the similarity of transition to chaos through homoclinic bifurcations" investigated the dynamics of a system of two differential equations with the equilibrium state "saddle-point-node" of the type of a Lorentz system. In investigating the properties of similarity at the boundary of chaos two types of similarity have been distinguished—a Feigenbaum and a quasiperiodic type. The renormgroup technique has been used for the determination of universal constants. The communication by G. P. Berman *et al.* is devoted to the problem of the interaction of two nonlinear resonances in a quantum system. In the domain of weak interaction a renormalization approach has been developed to describe the dynamics of a system and the structure of quasienergy functions. The paper by R. Limá (Marseille, France) "Some problems associated with dynamic systems" gives a review of some interconnections between the properties of dynamic systems and solid state physics models. At a session of the section on dynamic chaos the reports of M. V. Yakobson *et al.* "Feigenbaum universality and multipliers of $2n$ -cycles for many-dimensional systems," of S. P. Kuznetsov on "Renormgroup approach to the analysis of a class of nonlin-

ear media at the threshold of appearance of dynamic chaos," of L. A. Bunimovich "Critical phenomena in a Lorentz periodic gas," of K. M. Khanin "Construction of a stationary point and the problem of uniqueness in Feigenbaum's universality theory," of A. I. Komech and Yu. M. Sukhov "Stabilization of static solutions and the hydrodynamic limiting transition in statistical mechanics and field theory" were also presented.

The paper by I. R. Yukhnovskii "The liquid-gas critical point" was devoted to the study of the partition function of a system of atoms interacting by means of a long-range and a short-range potential, reduced to the Ginzburg-Landau-Wilson form. After replacement of the coefficient functions in this form by functions that depend only on the average density of the number of particles a possibility appears of utilizing renormgroup methods. In the communication of R. O. Zaitsev the concept of a metallic order parameter was utilized in the theory of metal-dielectric phase transitions. Calculation of critical exponents was carried out by the renormgroup method for a model of the Lorentz type where it turned out to be possible to calculate all the indices in a space of $4-\varepsilon$ dimensions. In this same direction papers were presented to M. P. Kozlovskii "Region of applicability of renormgroup relations in describing a phase transition of the second kind," by R. L. Dobrushin "Induction in terms of volume . . . and no cluster expansions of any kind," by P. M. Blekher "Rigorous results in the investigations of critical phenomena by the renormgroup method," by A. Solokov "Renormgroup, disorder and tricritical points," by B. M. Shalaev "Phase transition in Ising's two-dimensional model with impurities" and of R. Leven (Geifswald, GDR) "Critical behavior of Lyapunov exponents for transition points in nonlinear dynamic systems."

S. P. Obukhov in his paper "Scaling models in polymer physics" discussed the structure and elastic properties of clusters in the percolation problem, and also the structures arising in strictly irreversible processes of aggregation or polymerization. V. I. Alkhimov discussed in his report the problem of the "excluded volume" in polymer chains. A. Yu. Grosberg in his report "The method of the dynamic renormgroup in the statistical theory of biopolymers" proposed a variant of the renormgroup treatment based on a sequential elimination of fast modes in the "equation of motion" with a simultaneous increase in the scale of the chain. With its aid the problem was solved of the coil-globule transition in a chain with a random sequence of links and the process was investigated of the formation of a globular structure passing through the metastable state—a wrinkled globule.

The paper by M. A. Mnatsakanyan "Renormgroup analogies in astrophysics" contains a summary of group relationships for characteristics of a radiation field in nonlinear problems of plane transport theory. A discussion is given of the astrophysical example of the inverse problem of determining the distribution function of the frequencies of stellar flare-ups in aggregates and the possibility is indicated of using the group approach to problems of dynamic stellar systems. The communication of E. G. Yanovitskii was devoted to a new form of the transport equation in the case anisotropic scattering.

The proceedings of the Conference will be published by the publications division of the Joint Institute for Nuclear Research, and their translation into English will be published by the "World Scientific" publishing house.

Translated by G. M. Volkoff