MEETINGS AND CONFERENCES

Conference on Group-Theory Methods in Physics (Kiev, 18–21 October 1977)

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Usp. Fiz. Nauk **125**, 569–570 (July 1978)

The theory of groups and their representations is one of the divisions of modern mathematics that are finding steadily increasing use in a wide variety of areas in physics. Groups and their representations are the basis for study of the symmetries of both classical and quantum physical systems. The importance of the theory of representations in solutions of many theoretical physical problems has increased to the point that several of its divisions have been incorporated organically into the arsenal of mathematical physics. However, communication and collaboration between mathematicians working in the field of group-representation theory and physicists who use the methods of this theory are still inadequate, and the time is therefore ripe for coordination of their research and broader exchange of information.

This was the objective of the first All-Union Interdepartmental Conference on "Group-Theory Methods in Physics," which was organized by the Institute of Theoretical Physics of the Ukranianian Academy of Sciences. Scientific workers from various cities of the Soviet Union: Moscow and Moscow Oblast', Kiev, Leningrad, Minsk, Vilsnyus, Baku, Khar'kov, Novosibirsk, Irkutsk, Uzhgorod, Dnepropetrovsk, and others participated in the work of the conference. Interest in the conference was stimulated by the presence of some of the country's leading scientists: the mathematicians F. A. Berezin, N. Ya. Vilenkin, M. I. Graev, D. P. Zhelobenko, and A. A. Kirillov and the physicists Ya. A. Smorodinskiĭ, Yu. M. Shirokov, Yu. F. Smirnov, A. M. Perelomov, and others.

The conference was organized to work in the following basic areas: 1) Divisions of group-representation theory that have a bearing on physics; 2) group-theory methods in field theory and elementary-particle physics; 3) methods of group theory and representation of groups in nuclear and atomic physics; 4) group-theory methods in the study of radiation. The conference heard 21 papers and 43 original communications.

A paper by N. Ya. Vilenkin (Moscow State Pedagogical Correspondence Institute, MGZPI) was devoted to new results in the theory of special functions. Among other things, he cited an explicit form of the matrix elements of an arbitrary irreducible unitary representation (generalized Wigner d-functions) of a group of unitary matrices of arbitrary order, which will undoubtedly find applications in physical problems. New results in the theory of matrix elements of finite transformations of linear representations of compact and noncompact groups and the special functions of mathematical physics that are associated with them were discussed in a paper and communications from scientific staff of the Ukrainian Academy of Sciences Institute of Theoretical

Physics: A. M. Gavrillk, P. I. Golod, A. U. Klimyk, and V. A. Shirokov, and in communications from E. L. Surkov (I. V. Kurchatov Institute of Atomic Energy (IAE)) and his co-workers N. Ya. Vilenkin, L. M. Klesova, A. I. Nizhnikov, A. P. Pavlyuk, and M. A. Shleĭnikova. In particular, reference was made to the effectiveness of the method of representations of the basic nonunitary series of semisimple Lie groups in the approach to the matrix elements and Clebsch-Gordan coefficients of representations of compact and noncompact groups. This procedure illuminates the relation between the matrix elements and the Clebsch-Gordan coefficients of various series of representations.

D. P. Zhelobenko (Patrice Lumumba University) reviewed recent advances in the theory of representations of semisimple Lie groups. He spoke on the classification of irreducible representations of real semisimple Lie groups, which has, in principle, been completed during the last few years.

Yu. F. Smirnov (Moscow State University Scientific Research Institute of Nuclear Physics, NIIYaF MGU) presented a paper on projection operators in the theory of group representations and their applications. The method of using projection operators in infinitesimal form has proven highly effective in the derivation of representation bases and operators.

F. A. Berezin (Moscow State University Mathematics Department) reported on representation of Lie supergroups and superalgebras. Lie superalgebras are the basis for study of the supersymmetries that were discovered not so long ago by Soviet and foreign physicists. Representations of Lie superalgebras exhibit many properties similar to those of the corresponding semisimple Lie algebras. Berezin discussed the general principles of quantization and their relationships to representations of Lie groups. An interesting paper on the algebraic and topological structures of quantum and classical mechanics, the ambiguity of the quantization procedure, and the possibilities of other mechanics was presented by Yu. M. Shirokov (NIIYaF MGU).

A paper by Ya. A. Smorodinskiĭ (I. V. Kurchatov Institute of Atomic Energy) on "Harmonics for Three Particles and Transformations of Trees" and communications from his colleagues G. I. Kuznetsov and V. D. Éfros were devoted to the application of hyperspherical functions in various coordinate systems to problems of nuclear physics. The apparatus of hyperspherical functions and their transformation matrices has been developed successfully and put to use by these scientists. The use of generalized hyperspherical functions in the theory of collective excitations of atomic nuclei was

discussed by V. I. Ovcharenko (Ukrainian Academy of Sciences Institute of Theoretical Physics). Communications from R. I. Kalinaukas and A. K. Petrauskas of the Lithuanian Academy of Sciences Institute of Physics were devoted to other applications of the group-theory approach to nuclear physics problems.

Papers and communications from Belorussian scientists (A. A. Bogush, A. V. Berezin, Yu. A. Kurochkin, and V. S. Otchik) reported on a covariant procedure for finite transformations and the associated bivector parametrization of the Lorenz complex group that are being developed under the direction of F. I. Fedorov, Academician of the Belorussian Academy of Sciences. A. A. Bogush presented examples of application of this procedure in quantum field theory.

A. M. Perelomov [Institute of Theoretical and Experimental Physics (ITÉF)] presented an instructive paper on "Fully Integrable Hamiltonian System Related to Semisimple Lie Algebras." The speaker and his colleagues are making productive use of group-theory methods in their research. The group properties of fully integrable systems were discussed in a paper by V. G. Konopel'chenio (Institute of Nuclear Physics, USSR Academy of Sciences Siberian Division). V. I. Man'ko [P. N. Lebedev Physics Institute of the Academy of Sciences (FIAN)] reported on motion integrals, the symmetry of the equations of motion, the dynamic symmetry of physical systems, and the relationships among these aspects, using concrete physical systems as examples. Nonlinear generalizations of the Klein-Gordon equations were the subject of a communication from Yu. A. Danilov (IAE).

An original approach to elementary-particle theory

that does not use the quantized-field category was described by M. V. Menskiĭ [All-Union Scientific Research Institute of Physicotechnical and Radiotechnical Measurements (VNIIFTRI)]. This approach is based on the concept and properties of induced transformations. Papers on group methods in the theory of Feynman integrals, which describe Feynman diagrams, were presented by G. I. Kuznetsov and V. A. Golubeva.

Further development of the physical aspects of Lie group representation theory (the invariants of the representations, Clebsch-Gordan coefficients, Racah coefficients) was reflected in papers by Í. A. Verdiev (Azerbaĭdzhan Academy of Sciences Institute of Physics), S. A. Alishauskas [Lithuanian Academy of Sciences Institute of Physics, and V. P. Karasev (FIAN)].

The conference heard many interesting communications. All bear witness to the fact that group-theory methods are winning increasing recognition among theoretical physicists. Most of the communications contained original results that are important from both the general scientific and applied viewpoints. It is also indicative that many capable young people are working in these areas.

Plans for future research and opportunities for broader scientific contacts among various groups of scientists working in related areas were discussed during the course of the meeting. The conference proceeded actively, in a businesslike but relaxed atmosphere, and was unquestionably useful both to the physicists and to the mathematicians. The participants favored regular convening of similar conferences in the future.

Translated by R. W. Bowers