PREFACE

In 1989 Pushchino held the first All-Union Workshop on polaron under the title "*Polaron excited states in condensed medium*". The workshop dealt with the problems of polarons in polymers, polarons in biological systems and with the general problems of the polaron theory in application to the condensed state physics and superconductivity.

The Workshop proceedings were published in Russian and in English [1].

In 1990 Pushchino held a local conference, devoted to the problem of numerical solution of nonlinear differential equations of the polaron theory.

An International Workshop (1992) whose proceedings are presented by this volume, was aimed at discussing of the major trends of polaron physics including polarons in biology and purely mathematical problems of the polaron theory.

At present the number of works on polaron is so abundant that they can not be covered within one session.

This Workshop is the fourth traditional international Conference on polaron physics, (and the first one in Russia). The preceding conferences were held at ten year intervals:

1962 "*Polarons and excitons*" (USA), Edinburg 1962

1972 "*Polarons in ionic crystals and polar semiconductors*" (Belgium), Antwerp, 1972

1982 "*Polarons and Excitons in polar semiconductors*" (Belgium), Antwerp, 1982.

The idea of polaron was first introduced by Landau as early as in 1933. But the model approach lead Landau to the erroneous conclusion of a fluctuation barrier for the polaron. In 1946 Pekar found an approximate solution of the polaron phenomenological problem, using the variational method. Finally, in 1950 Bogolubov derived polaron equations from the equations of the quantum theory of field and thereby made the polaron a lawful object of

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theoretical physics.

Since then (especially after the Froelich work, 1950) polaron theory has been developed all over the world. Polaron, soliton and other quasi-particles are treated as manifestations of nonlinearity of quantum fields. The study has been however concentrated only on the ground state. The excited states were first found in the model problem - Geinzenberg's "Psi-cube equation". Then (practically at the same time) they were identified in the polaron problem, which has brought up a need for more extensive studies: nonspherical solutions, excited states, the dependence on parameters, bifurcation phenomena, new applications, *etc.* This requires joint efforts on the part of physicists, biologists, mathematicians and programmers. The progress in the field is not only determined by theoretical and calculative results but essentially depends on the organizing work.

We hope that the Workshop has contributed to the exchange of information and fresh ideas between the scientists in this rapidly evolving field and provided the basis for further close cooperation. This is just the aim of the present proceedings.

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[1]. *Excited polaron states in condensed media.* Ed. V.D.Lakhno, Manchester Univ. Press., 1991.