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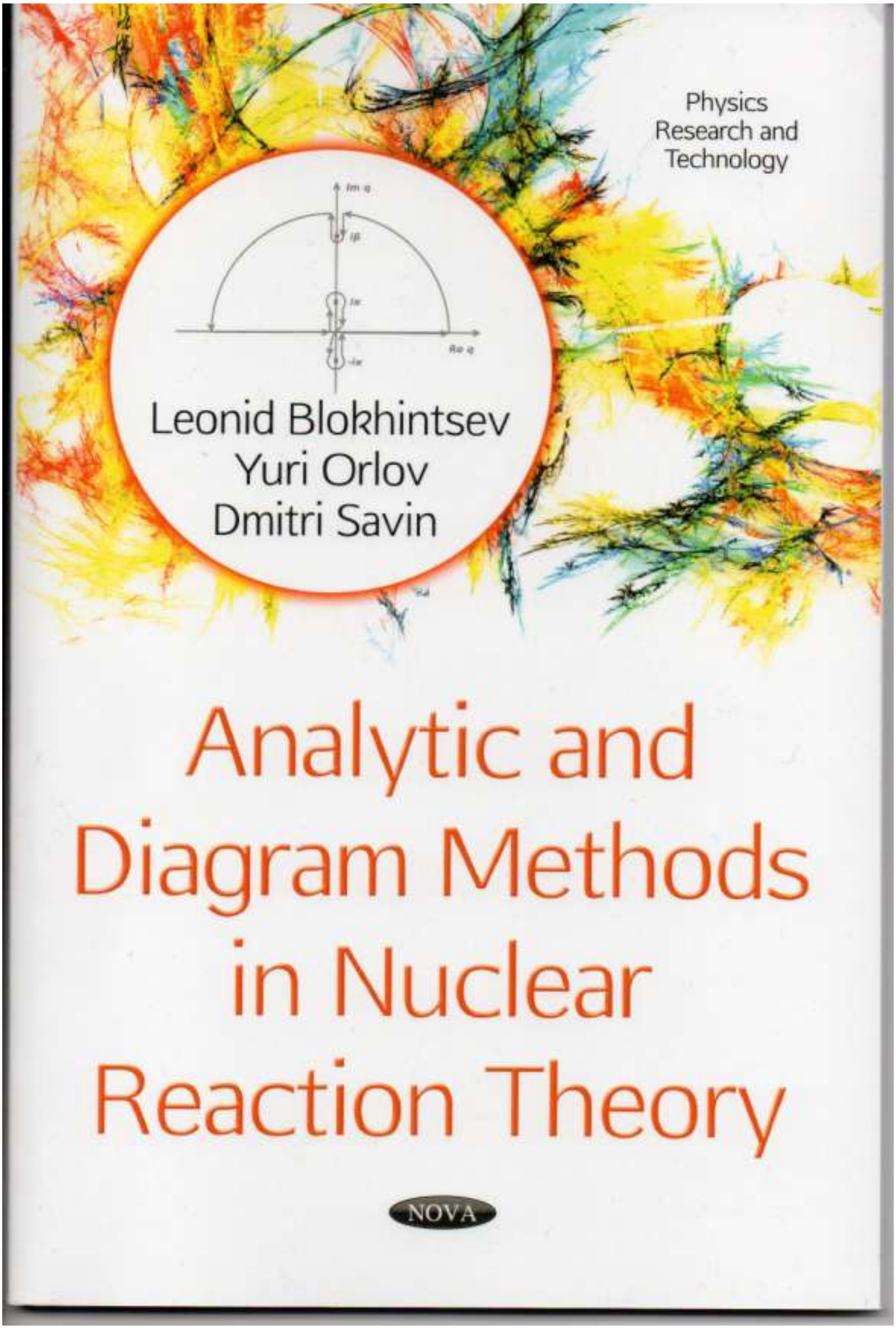

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Analytic and Diagram Methods in Nuclear Reaction Theory

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Authors: Leonid Blokhintsev, Yuri Orlov, and Dmitri Savin (Principal Researcher, Skobeltsyn Institute of Nuclear Physics, Lomonosov Moscow State University, Moscow, Russia, and others)

Book Description

Using the analyticity property of the amplitudes of physical processes allows one to obtain important relations connecting various physical quantities. These relations can be established without specifying the concrete form of the interaction between particles, which is often poorly known. The analytic methods make use of the unitarity property of the S-matrix and the formalism of the Feynman diagrams. The present book is devoted to a systematic description of the analytic and diagram methods in the theory of nuclear reactions at low and intermediate energies. First, a general overview of the unitarity and analyticity properties of the S- and T-matrices is presented. Then the general theory of non-relativistic Feynman diagrams, their specific features and the analytic properties of their amplitudes is described. Three- and four-prong vertex functions of the non-relativistic Feynman diagrams are among the topics that are addressed and discussed, including the important relation between vertex functions and the asymptotic form of the nuclear bound-state wave functions. Specific approaches to describing nuclear reactions, which use analytic and diagram methods are outlined. These methods include the dispersion K-matrix approach, the dispersion relations, and the Trojan horse method. A part of the book deals with the asymptotic normalization coefficients (ANCs). ANCs are fundamental nuclear characteristics that are important in nuclear reaction and nuclear structure physics as well as in nuclear astrophysics. They are used actively in the analysis of nuclear reactions, in particular in considering the creation of elements in the Universe. Various methods of determining ANCs are overviewed. One chapter of the book is devoted to the methods of obtaining information on the features of bound nuclear states by an analytic continuation of the scattering data. The analytic continuation of the Lippmann-Schwinger and Faddeev integral equations onto unphysical energy sheets, which can be used for finding the position and width of resonances and the virtual (antibound) states is described. A generalization of wave function normalization to the Gamow states is outlined. (Novinka)

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