BOOK REVIEWS

Rotation-Vibration of Polyatomic Molecules (Higher Order Energies and Frequencies of Spectral Transitions)


In the last few years tremendous developments in instrumentation and emergence of new powerful experimental techniques have made it possible to obtain the rotation and rotation-vibration spectra of polyatomic molecules to a remarkable degree of precision. The interpretation of such high-resolution spectra demands use of equally accurate formulae and the monograph under review is designed to meet this need for high order energy calculations.

The book is divided into three parts. In Part 1 the expanded rotation-vibration hamiltonian is discussed in detail. The authors here choose the analytical form of the hamiltonian, most suitable for computation, and expand it in a power series up to fourth order with respect to normal coordinates. Algebraic, rather than numerical diagonalization techniques are employed, and to this end successive unitary transformations leading to block diagonalization are applied. The transformed hamiltonian, up to second order of the perturbation parameter, is thoroughly discussed. Part 2 deals with computation of off-diagonal non-vanishing matrix elements associated with degenerate vibration and rotational interaction. Part 3 discusses the computation of rotation-vibration energies as solutions to the root of secular equations involving the hamiltonian, using the matrix elements discussed in Part 2. Frequencies of rotational transitions are given for the simplest vibrational levels up to sixth order and frequencies of rotation-vibration transitions are computed up to fourth order. As the secular equations are perturbationally solved, the expressions for frequencies are analytical and therefore very general. Extensive tables are given for frequencies of axially symmetric molecules with three, four-fold and infinite-fold symmetry axis, and will be very valuable for persons engaged in high-resolution vibration-rotation spectroscopy. The only limitation of the book is the absence of any discussion of spectral intensity—another invaluable source of information to spectroscopists and theoreticians.

D.M. de M. G.
Within the short compass of 167 pages the author discusses a very large number of topics of quantum field theory. Starting with Wentzel's well known book many treatises on quantum field theory have appeared. Almost all of them are meant for those who aspire to become theoretical physicists. This book, on the other hand, aims at introducing, in a brief period of time, the essentials of quantum field theory to students of diverse interests, few of whom plan to become theoretical physicists. Quantum field theory is an abstract subject using sophisticated techniques of mathematical physics. Hence the task undertaken by the author is not at all easy.

In the first chapter, the author narrates very briefly the formal structure of quantum mechanics. Then he goes to the problem of quantisation of radiation field and treats a few problems of interaction between radiation and matter (Chapters 2 and 3). In Chapter 4, the formal development is enlarged by quantising the field of ψ-functions generated by particles, the so called second quantisation procedure. Thus both the classical field and the classical particle are treated as quantised fields. In Chapters 5 to 9 are discussed the application of this formalism to many problems selected from diverse branches of physics. In the last chapter, the question of divergence in quantum field theory and its removal by renormalisation procedure is discussed.

The emphasis in the book is on getting answers to specific physical problems by the application of the formalism of quantum field theory. The formalism itself is developed briefly and in an elementary way. To those who want to see, without spending a lot of time on the details of mathematical finesse, how quantum field theory actually tackles problems, the book will certainly be very useful. A theoretical physicist, whose main interest does not centre round field theory will also find the book helpful as a reference work that can be glanced through quickly. The book contains several topics such as Glauber's theory of coherent states of e.m. field, quantum theory of Cerenkov radiation etc., which are not usually found in books on field theory. The book, however, entirely omits a discussion on covariant development of perturbation theory using interaction representation which is such a powerful tool in quantum field theory. A brief discussion on this would have increased the utility of the book.

S. S.
Vibrational States and Transitions

The simplest case is a diatomic molecule. Rotations (2) and translations (3) leave only one vibrational degree of freedom, the bond length change, $\Delta r$, a one dimensional harmonic oscillator. One can solve this problem exactly as a classical Hook's law problem with a restoring force: $F = -k\Delta r$ and potential energy: $V = \frac{1}{2} k(\Delta r)^2$

Quantum mechanically: $E_v = (v + \frac{1}{2}) \hbar \nu$, $n$ is the vibration frequency.

To view this video please enable JavaScript, and consider upgrading to a web browser that supports HTML5 video.

Spectral Regions and Transitions. Published by Evan Byrd Modified over 4 years ago. Embed. For a diatomic molecule the vibrational and rotational energy levels are quantized and the selection rules are (vibration) and (rotation). Only transitions that meet the selection rule requirements are allowed, and as a result discrete spectral lines are observed, as shown in the bottom graphic. The position of a spectral line corresponds to the energy difference between the initial and final states of the transition. These energy level transitions from the ground to excited rotation-vibration states are shown in the top graphic. The spectrum consists of a branch $\ldots$, smaller wavenumbers, low Start by marking Rotation Vibration Of Polyatomic Molecules; Higher Order Energies And Frequencies Of Spectral Transitions as Want to Read: Want to Read saving… Want to Read. Currently Reading. Read. Rotation Vibration Of Polyatomic Molecules; Higher Order Energies And Frequencies Of Spectral Transitions by G. Amat. Other editions. Want to Read saving… Error rating book. Refresh and try again. Rate this book. Clear rating. 1 of 5 stars 2 of 5 stars 3 of 5 stars 4 of 5 stars 5 of 5 stars. Open Preview. See a Problem? We'd love your help. Let us know what's wrong with this preview of Rotation Vibration Of Polyatomic Molecules; Higher Order Energies And Frequencies Of Spec...