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Book reviews

The Geometric Phase in Quantum Systems

A Bohm, A Mostafazadeh, H Koizumi, Q Niu and J Zwanziger
2003 Heidelberg: Springer-Verlag
447 pp US$79.95 (hardback)
ISBN 3-540-00031-3

The discovery of the geometric phase is one of the most interesting and intriguing findings of the last few decades. It led to a deeper understanding of the concept of phase in quantum mechanics and motivated a surge of interest in fundamental quantum mechanical issues, disclosing unexpected applications in very diverse fields of physics.

Although the key ideas underlying the existence of a purely geometrical phase had already been proposed in 1956 by Pancharatnam, it was Michael Berry who revived this issue 30 years later. The clarity of Berry's seminal paper, in 1984, was extraordinary. Research on the topic flourished at such a pace that it became difficult for non-experts to follow the many different theoretical ideas and experimental proposals which ensued. Diverse concepts in independent areas of mathematics, physics and chemistry were being applied, for what was (and can still be considered) a nascent arena for theory, experiments and technology. Although collections of papers by different authors appeared in the literature, sometimes with ample introductions, surprisingly, to the best of my knowledge, no specific and exhaustive book has ever been written on this subject.

The Geometric Phase in Quantum Systems is the first thorough book on geometric phases and fills an important gap in the physical literature. Other books on the subject will undoubtedly follow. But it will take a fairly long time before other authors can cover that same variety of concepts in such a comprehensive manner.

The book is enjoyable. The choice of topics presented is well balanced and appropriate. The appendices are well written, understandable and exhaustive—three rare qualities. I also find it praiseworthy that the authors decided to explicitly carry out most of the calculations, avoiding, as much as possible, the use of the joke 'after a straightforward calculation, one finds ...' This was one of the sentences I used to dislike most during my undergraduate studies. A student is inexperienced in such matters and needs to look at details.

This book is addressed to graduate physics and chemistry students and was written *thinking* of students. However, I would recommend it also to young and mature physicists, even those who are already 'into' the subject. It is a comprehensive work, jointly written by five researchers. After a simple introduction to the subject, the book gradually provides deeper concepts, more advanced theory and finally an interesting introduction and explanation of recent experiments. For its multidisciplinary features, this work could not have been written by one single author. The collaborative effort is undoubtedly one of its most interesting qualities. I would definitely recommend it to anyone who wants to learn more on the geometric phase, a topic that is both beautiful and intruiguing.

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The Mathematical Aspects of Quantum Maps

Lecture Notes in Physics 618
Mirko Degli Esposti and Sandro Graffi (ed)
2003 Heidelberg: Springer-Verlag
175 pp EUR49.95 £35.00 SFR86.00 US$59.95
(hardback) ISBN 3-540-02623-1

The book represents the collected lectures given at the Summer School on Mathematical Aspects of Quantum Maps held at Bologna University in September 2001.

Quantum maps gained their prominence as a testing ground for mathematical understanding of various concepts in quantum chaos, such as the spectral statistics, quantum ergodicity, scarring of the eigenfunctions and the connection to algebraic number theory.

The book is nicely structured. It begins by reviewing the relevant concepts and results from dynamical systems (a contribution by A Knauf) and number theory (by Z Rudnick). A contribution by the editors, M Degli Esposti and S Graffi, explains the quantization procedure for the quantum maps and proceeds to discuss some properties of the quantized maps, such as ergodicity and scarring, and the number theoretical techniques involved in proving these properties. The contribution by A Bäcker discusses the numerical methods used to study quantum chaotic systems. It contains

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