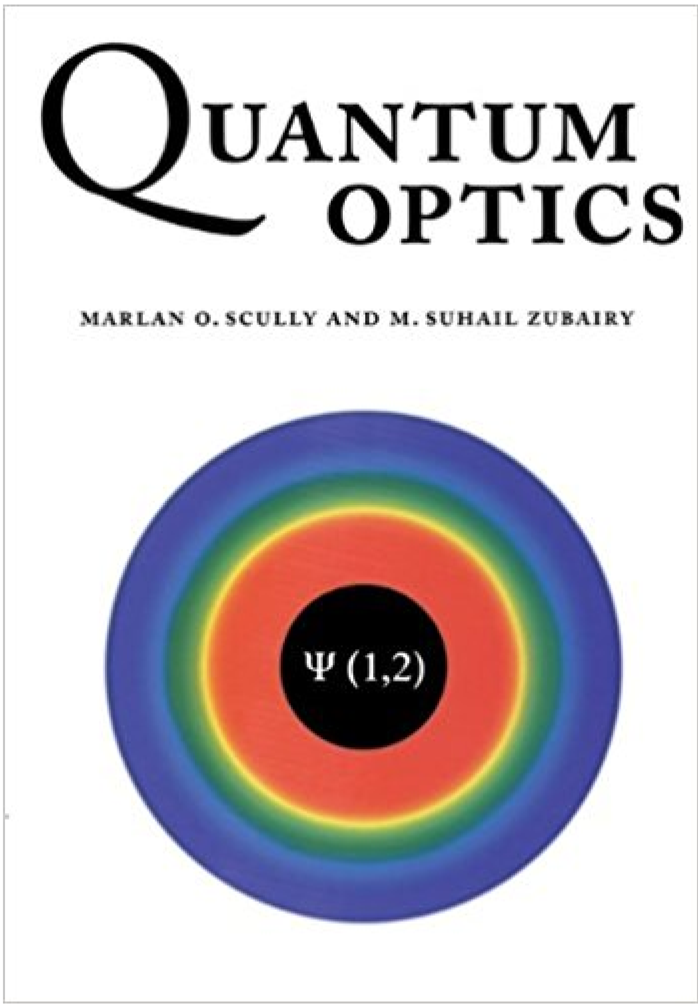
Quantum Optics



Synopsis

The field of quantum optics has witnessed significant theoretical and experimental developments in recent years. This book provides an in-depth and wide-ranging introduction to the subject, emphasising throughout the basic principles and their applications. The book begins by developing the basic tools of quantum optics, and goes on to show the application of these tools in a variety of quantum optical systems, including lasing without inversion, squeezed states and atom optics. The final four chapters are devoted to a discussion of quantum optical tests of the foundations of quantum mechanics, and to particular aspects of measurement theory. Assuming only a background of standard quantum mechanics and electromagnetic theory, and containing many problems and references, this book will be invaluable to graduate students of quantum optics, as well as to researchers in this field.

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Customer Reviews

This is actually a really good book! The authors are authoritative when it comes to discussing some finer points and/or controversial aspects of QO. The writing style can be terse at times, and it helps to have another QO book around for a second reference. Some others I found useful are Agarwal and Walls/Milburn.

There are three topics that I found of particular interest in this book.The first such topic was that of squeezed states in chapter 2. This topic is addressed with the help of the propagator for the quantum harmonic oscillator. The authors do not derive the propagator in this book, but suggest that it might be found in a quantum mechanics textbook. I should note that this propagator was not found in the QM textbooks that I own, but I was able to find its derivation online in the notes for the first semester of QM course given at University of Illinois (Physics 480--a course designation that has not changed in 40 years!) taught by Klaus Schulten. This derivation is found on pp.81-83 in chapter 4 of his notes.Also of interest to me is chapter 16, which deals with squeezing via non-linear optical processes, and chapter 18 which discusses the EPR process, hidden variables, and Bell’s theorem.

I am a mathematician with extensive experience in electrodynamics andquantum mechanics. I read this book to teach myself quantum optics.Since I read it as a self-study text,I will review it from that perspective. I didn’t find this to be a good pedagogical book.It is the first quantum optics book that I read,and I didn’t get much out of it.Thinking that perhaps the problem was inadequate background,I then read from cover to cover Elementary Quantum Optics by Gerry and Knight.Although there are some problems with the latterwhich are addressed in a separate review,it did make more sense. With Gerry/Knight under my belt,I returned to reread Scully/Zubairy.It didn’t make much more sense the second time than the first. The presentation of Scully/Zubairy is often sloppyand too diffuse. Like too many physics texts, itdoesn’t always carefully define all its symbols, andit frequently sneaks in important assumptionswithout explicit mention.It demands a lot of guesswork from the reader. For example, Chapter 1 tells us that "as we will discuss in [Chapter 4], the probability of exciting an atom ... is governed by [formula (1.5.12)]".This is a crucial formula, one of the most important in the book.If the reader turns ahead to Chapter 4,he does reassuringly find it in equation (4.2.4).The impression given is that it has somehow been derivedin the intervening 100-odd pages.But it hasn’t,so far as I have been able to discover. Is this crucial formulaa new assumption of quantum optics,or does it somehow follow fromestablished quantum-mechanical principles?The reader is left to guess.Readers who are satisfiedto accept unmotivated statements on authoritymay be happier with this book thanreaders who seek a fundamental understanding ofthe logical structure of the subject. I was particularly interested in theHanbury Brown and Twiss experiment treated in Chapter 4,so I read that chapter particularly carefully.Indeed I read it very carefully several times,but I was forced to consult other sourcesto understand this experiment.I think that the text's treatment omits important,non-obvious assumptions and contains some errors.However, study of other sources finally convinced me thatthe text's final result, equation (4.1.26),is probably correct.(Incidentally, I think that the treatmentof this important experiment in Gerry/Knight is also inadequate.) Figure (4.6) which purports to bea diagram of this experimentcontains a component which produces a "delay time",but the text's analysisnever explains the purpose of this component.From other sources I've learned thatthe delay time is extremely importantfor some variants of this experiment.This is fairly typical of the text's haphazard approach. Chapter 20 discusses a "quantum eraser" experiment whoseresult is so startling that Scully and Zubairycite Jaynes as considering ita paradox, a "violent irrationality"(as Scully and Zubairy paraphrase Jaynes).It certainly seems that way to me,and I would very much like to understand this experiment better. Scully and Zubairy never make clearif this is an actual experiment which has been performed,or a "thought experiment".Surely the exposition of such remarkable claims should be more explicit. They present a calculation which is claimed to"resolve the 'Jaynes paradox'".I was disappointed that I could not follow this calculation becauseits exposition is far too vague.In particular, they obtain their main result, equation (20.3.5),under the assumption that "the interaction Hamiltonian ... dependson symmetric combinations of the field variables, so that only the symmetricstate ... will couple to the fields".This might be convincing if they had ever defined their "interaction Hamiltonian",but the reader is left to guess at which interaction Hamiltonian they might be using. I cannot recommend this book for readerswho are not experts in quantum optics.I cannot judge whether it might be useful to experts.

This is an outstanding text in the quickly expanding field of quantum optics, by an author producing some of the most revolutionary experiments. Although my only objective is the order materials are presented, it is comprehensive and easy to understand. One of only 2 or 3 exceptional texts on the topic.Mark Brezinski MD,PhD Harvard, BWH, MIT

Compared to Wolf and Mandel's tome "Optical Coherence and Quantum Optics", this book gives the reader a lighter job on math without him reading over 100 pages on probability theory and fourier transform. However, this book has two major drawbacks:1. The author keeps refering to later chapters on some important concept. When I read the first two chapters, I have many undefined concept and unanswered questions, whose answer may be put in chapter 16! For those who are already familiar with this field, it may not be a problem. But a rookie may want a lucid and detailed introduction in the beginning.2. Some calculation should be elaborated because the result is far from obvious.

This book is, in a word, excellent!! It places the reader on the cutting edge of science and technology, explains many of the more complicated topics in an easily understood manner, and takes the cookies off the top shelf that all might be able to eat them. Chapters are well thought out, organization of topics is great! A must have for any "serious" student in the field.

This is the best introductory text on quantum optics that I've read. Its very clear and up to date. The only book that compares as far as clarity of presentation is Loudon's "Quantum Theory of Light" which is a little out of date. This book is a must have for any grad. student in AMO physics !