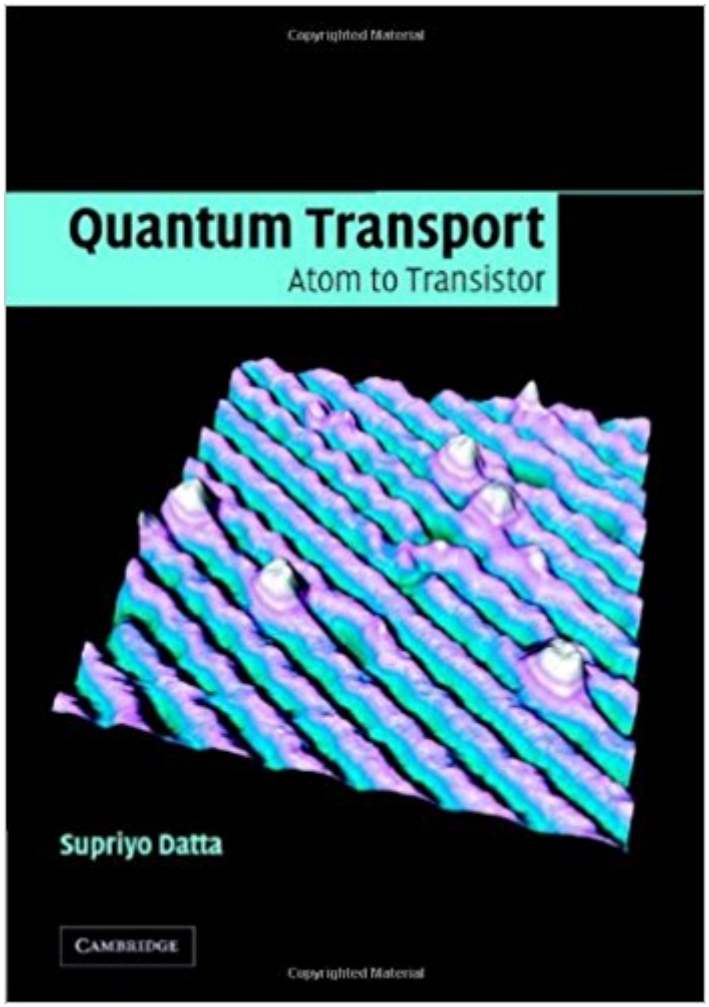
# Quantum Transport: Atom To Transistor



## Synopsis

Including some of the most advanced concepts of non-equilibrium quantum statistical mechanics, this book presents the conceptual framework underlying the atomistic theory of matter. No prior acquaintance with quantum mechanics is assumed. Many numerical examples provide concrete illustrations, and the corresponding MATLAB codes can be downloaded from the web. Videostreamed lectures linked to specific sections of the book are also available through web access.

## Book Information

Hardcover: 420 pages

Publisher: Cambridge University Press; 2nd edition (July 11, 2005)

Language: English

ISBN-10: 0521631459

ISBN-13: 978-0521631457

Product Dimensions: 6.8 x 1.1 x 9.7 inches

Shipping Weight: 2 pounds (View shipping rates and policies)

Average Customer Review: 4.2 out of 5 stars 6 customer reviews

Best Sellers Rank: #903,645 in Books (See Top 100 in Books) #60 inÂ Books > Engineering & Transportation > Engineering > Electrical & Electronics > Electronics > Optoelectronics #808 inÂ Books > Science & Math > Physics > Quantum Theory #29043 inÂ Books > Textbooks > Science & Mathematics

## Customer Reviews

"In recent years, scientists have developed a powerful practical technique based on Green function methods for calculating transport through small open systems. Supriyo Datta is one of its leading exponents and his new textbook makes a valiant and fascinating effort to use the formalism to provide a simple exposition of quantum transport on the atomic scale ... It is more accessible, more embracing and a much better read than his earlier monograph ... It contains excellent examples, good breadth and progressive detail, and is of real value to electronic engineers, physicists, and chemists researching modern interdisciplinary nanoelectronics." Chemistry World"Molecular transport phenomena in junctions is a very ’hot’ area, that is best understood in terms of quantum transport phenomena in general. This book, by one of the true leaders in this field, presents and clarifies molecular transport in the context of the larger quantum transport area. The text is lucid, masterful, understandable and unified. The numerical examples and MATLAB codes combine with

the discussions to provide a strongly integrated and very readable overview of the field." Mark Ratner, Professor of Chemistry, Northwestern University, Illinois"A lucid treatment of what’s destined to be the "ext big thing"for electrical engineers - conduction at the atomic scale - eminently suitable for students and professionals alike. The generous use of examples and clarifying remarks, together with the novel approach of sequentially building up transport theory from the ’bottom up’ and a genuine flair for effortlessly bringing together salient aspects of physics and engineering makes this a very useful book, indeed." Dr Steve Laux, IBM, Yorktown Heights

This book presents the conceptual framework underlying the atomistic theory of matter, emphasizing those that relate to current flow. This includes some of the most advanced concepts of non-equilibrium quantum statistical mechanics. No prior acquaintance with quantum mechanics is assumed. Many numerical examples are used to provide concrete illustrations and the corresponding MATLAB codes can be downloaded from the web. Videostreamed lectures, keyed to specific sections of the book are also available through the web. Written for senior and graduate students.

The author (SD) claims that this is a physics book written for engineers. Maybe that explains why, unlike the authors of most physics books written for physicists, he doesn’t seem particularly concerned with elegance, concision, abstract generality or showing how clever he is in this book. Apparently, his main concern is to help you understand stuff. Not only that, but he’s chosen some very interesting stuff to tell you about.The narrative arc of the book is to show you how to get from a particle in a box to Ohm’s Law, as instantiated in nanoscale transistors. The path to doing this is already laid out in the first chapter, using a "toy" level of analysis. The next nine chapters lay out building blocks for attacking the problem using Green’s function (GF) techniques, which are a bit more modern and versatile than the transmission formalism favored in the past (including by SD in a previous book). The whole picture is put together in Chapters 11 and 12, followed by an appendix that shows (albeit quite tersely in comparison to the rest of the book) how the same problem is dealt with using a second-quantization (2Q) GF formalism. The fact many pieces of this arc are repeated at successively deeper levels of analysis is very helpful. So too are SD’s "big picture" introductions at the beginning of each chapter, and at the beginnings of the longer subchapters.Throughout, SD pauses to describe in words and pictures the physics behind pretty much each term of each equation -- a de-mystification that most authors of physics texts seem to avoid as if it were blasphemy. I was especially impressed when SD used these opportunities to allude to some deeper

and more general issues, such as how you get from time-reversible equations to irreversible physics. In fact the whole book serves as an applied introduction to non-equilibrium stat mech, a cutting-edge subject usually reserved for abstract theoretical treatment, or the last few pages of a conventional textbook. SD also foregrounds some basic points that are often buried in or missing from other texts, such as that the Schroedinger equations do not explain why atoms emit light, and why "optical" phonons are called that. (This latter point had really bugged me when I took a course in solid state years ago, so while reading this book I re-checked 7 or 8 solid state texts within reach, including Ziman, and found that only Kittel and Ashcroft & Mermin bothered to explain this point, and so casually (K) or vaguely (A&M) that you'd hardly notice.)I was especially struck by the book's attention to modeling transistor contacts and how they interact with the channel. In the last few years this has become a big issue in organic electronics, as researchers have found that many aspects of device behavior were far more dependent on the contacts than they'd previously appreciated (kind of a let-down after going to the trouble of synthesizing some exotic channel material). That said, though, note that the book's POV is restricted to inorganic crystalline semiconductors, and I don't claim to be smart enough to see how easy it is to extend the book's methods to organic devices.A couple of caveats. Although my copy says it was "reprinted with corrections 2006", there are still a lot of typos (none too terrible, though). More significant is that many of the exercises rely on your having access to MATLAB or some other math program. If you're not attached to an academic institution or didn't aquire a copy of such a program while you were so attached, those exercises probably will be inaccessible to you (unless you're willing to spring for ~ $10E2.6-$10E3.3 for a personal copy, depending on the program). Contrary to another review, there isn't anything about fabrication techniques, despite brief references to quantum dots and nanowires. And while the blurb on the back cover says "No prior acquaintance with quantum mechanics is assumed," and although SD does start from a description of the Schroedinger equation in Chapter 2, the QM intensity accelerates rapidly from there. So I wouldn't rely on learning the relevant QM from this book. (However, it might be possible to enjoy this book before you've finished a class in solid state.)For a next edition, I'd look forward to (i) a somewhat less rushed description of transmission formalism in sec. 9.4 (one of the few places in the book where EEs may have a real advantage over others), (ii) a wordier discussion of the 2Q formalism in the appendix, and (iii) a more explicit discussion of Fock space methods, which seem to play an uncredited role in the discussion of multi-electron systems in Chap.3. But even as-is, this is a very stimulating and enjoyable book.

Very good textbook though I found myself being confused sometimes ... I think that one can take full advantage of prof. Datta by supplementing the reading of this textbook with the ECE 659 lectures (the ones that are 50 mins long!) found on nanohub ... in those online lectures prof. Datta explains things in a much more detailed way than in his textbook, and I can safely say that he is just a perfect lecturer ... stressing particularly his ability to simplify things and convey messages.

Out of date by now.

The book is in great condition and was ok for the price. Ad i couldnt find it in any of my university book stores

Good Book for a general overview of Quantum Transport. This was a lite read

All i can say is that either the  service, the delivery time and the item were really excellent, i even got the item few days before the estimated delivery date.Thank you