

tion is the thing. Yet everyone who plans to be a serious cosmologist must endure the strength exercise of equation working to develop physical intuition. *Cosmology* is one book with which they can develop their chops. Moreover, Weinberg's reputation as a powerful and insightful derivator is without peer, so the reader can rest assured all equations are well vetted.

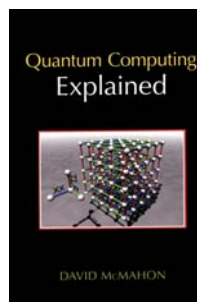
Cosmology is a worthy follow-on to *Gravitation and Cosmology* and continues the earlier work's effective, straightforward derivational approach. A technical tour de force for the intrepid graduate student, Weinberg's new book will greatly appeal to particle physicists tooling up in cosmology and be an indispensable source for the practitioner.

J. Richard Bond
University of Toronto
Toronto, Ontario, Canada

Quantum Computing Explained

David McMahon
Wiley Interscience, Hoboken, NJ,
2008. \$84.95 (332 pp.).
ISBN 978-0-470-09699-4

The field of quantum information has emerged from the intersection of quantum physics and information science as a rapidly growing area with both fundamental and technical significance.



Even as it advances our understanding of the unique properties of the quantum world, quantum information is addressing some of today's most challenging scientific and technological

questions. For example, quantum information processing leads to a revolutionary new paradigm for computation that has been shown to provide efficient solutions for such complex calculations as integer factorization, the basis for widely used cryptographic systems.

Quantum information processing has seen explosive growth since the mid-1990s, when experimental investigations to implement quantum computation began in earnest. Those investigations followed a decade of theoretical work that culminated in demonstrations of algorithms for quantum computation and error correction. An increasingly broad community of experimental and theoretical scientists, including chemists,

mathematicians, computer scientists, engineers, and physicists, is now seeking to realize and expand the promise of quantum information. As a result, the challenge for writers of textbooks on quantum computation is only becoming more complex.

As the field of quantum information continues to mature, an increasing number of textbooks on it and its related subfields are appearing; since 2001 at least five of them have been reviewed in *PHYSICS TODAY*. Most of those texts, written for graduate students and researchers, assume a familiarity with quantum mechanics. How-

ever, it is one thing to write a textbook about a new field for a specific community, and quite another to write a text that satisfies multiple communities. That challenge is particularly acute if the audience includes undergraduates or scientists and engineers who have not had any real exposure to quantum mechanical concepts.

In his book *Quantum Computing Explained*, David McMahon has picked up the challenge. He sets out to introduce the key concepts, features, and developments in quantum computation to undergraduates and professionals who do not necessarily have backgrounds in

Analog PID Controller

Don't build it, buy it!

Tired of designing your own PID control circuits?

Consider the SIM960—a programmable, low-noise, analog controller with configurable gain. It's ideal for demanding applications ranging from servo systems, to sensitive temperature control, to laser stabilization.

The SIM960 lets you implement high-gain, wide-bandwidth control loops without sampling artifacts. Smooth analog ramping between setpoints, and bumpless transfers from manual to PID modes, ensure glitch-free operation. All instrument parameters can be set from the front panel or a computer.

As a stand-alone instrument (DC powered), or as a module in the SIM900 mainframe, the SIM960 offers a powerful, versatile solution for common PID applications.

- 100 kHz bandwidth
- Analog signal path, digital control
- Low noise front-end
- Anti-windup (fast saturation recovery)
- Bumpless transfer (manual to PID)
- Analog setpoint with smooth ramping

• SIM960...\$1750 (US list)



Don't build it, buy the SIM960!



Stanford Research Systems

Phone: (408) 744-9040 • www.thinkSRS.com

Confocal Raman Imaging Atomic Force Microscopy

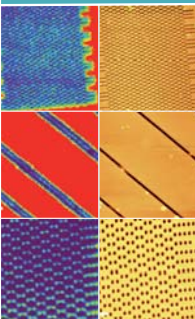


Confocal Raman Microscope
alpha300 R

Automated Raman-AFM
System alpha500

Ultrafast & Automated

The modular WiTec microscope system can combine ultrafast 3D chemical imaging with high resolution structural imaging for the most comprehensive materials characterization. Large sample/multi-point measurements can be performed quickly and accurately with the automated alpha500 series. Benefit from the most sensitive Raman/AFM imaging system available for setting the benchmark in your field of application.



Raman stress and AFM
topography images
recorded automated at
three different areas of a
Si-device.

Confocal . Raman . Fluorescence . SNOM . AFM

www.witec.de

WITec
focus innovations

WITec GmbH, Ulm, Germany
Tel. +49 (0)731 140700,
info@witec.de

either quantum physics or undergraduate mathematics. He does so with an informal, study-guide approach that involves a large number of worked examples and exercises. A research consultant at Sandia National Laboratories, McMahon is a practiced hand at this approach; he has written more than 10 teach-yourself texts on diverse areas of science and engineering. As he explains in his preface, the goal for his book is to open up and introduce quantum computation to nonspecialist readers from a wide variety of backgrounds.

Does it work? The book has some very attractive features, including a broad range of topics for an elementary text, some derivations of important results, and many examples worked in great detail. It is a good text for technically trained nonexperts who can follow simple mathematics and who wish to learn something of the intellectual content and context of quantum computation. On the whole, the book's style is very pedagogical. For instance, before readers tackle the more advanced exercises, they are guided through many worked examples that illustrate the ideas upon which quantum computation is based. Those worked examples will be helpful for undergraduates in fields other than physics and computer science, the primary fields that contribute to quantum information science.

The text may also be helpful as a study guide for undergraduate physics students. That audience, however, is likely to be less satisfied overall, because a large proportion of the text is devoted to the basics of quantum mechanics. Even physics students who have not yet encountered the notion of generalized measurements or discussions of entanglement in their quantum mechanics classes will likely not be challenged by the relatively elementary first 170 pages of the book.

A more significant drawback for physics students and others with a serious interest in the subject is the book's inconsistent approach to providing derivations of key results—some are given in detail while others are glossed over. Another drawback is the lack of references that could have provided further guidance, particularly for those topics that received only a cursory nod in the text. Expanded references would have been consistent with the author's goal to provide a foundation that can be built upon by consulting more advanced texts. A further lacuna is the absence of discussions of quantum information demonstrations—for example, the physical realization of a qubit—or

experiments that relate to quantum computation. Granted, the field is moving very quickly on the experimental side, but a short overview of physical implementations would be precisely the kind of thing that an educated non-expert would welcome. Experimental discussions and references are better handled in *Quantum Computing for Computer Scientists* (Cambridge University Press, 2008) by Noson Yanofsky and Mirco Mannucci, a recent text that aims to provide computer science undergraduates with a similarly gentle introduction to the topic.

However, as noted above, it is easier to write for a specific audience than for one with diverse interests and expertise. McMahon's text certainly conveys the excitement and some of the intellectual content of quantum computation to the nonphysicist who is prepared to invest some effort to understand both the theoretical framework and the conceptual underpinnings of the field.

K. Birgitta Whaley

University of California, Berkeley

Air-Ice-Ocean Interaction

Turbulent Ocean Boundary Layer Exchange Processes

Miles McPhee

Springer, New York, 2008. \$119.00
(215 pp.). ISBN 978-0-387-78334-5

The immensely complex interactions between the atmosphere, sea ice, and ocean limit the ability of scientists to understand recent change to polar climates. Exchanges of momentum, heat, and salt between the ocean and overlying sea ice are critical to the evolution of the sea ice; as a consequence, they influence the regional and global climate systems. Miles McPhee's descriptively titled monograph, *Air-Ice-Ocean Interaction: Turbulent Ocean Boundary Layer Exchange Processes*, is a timely contribution, given the recent attention being paid to the climate of the polar regions. As the author succinctly states: "Rapid and apparently accelerating changes in the state of the Arctic ice pack lend a sense of urgency: essentially, it seems that Nature is solving the equations a lot faster than we are."

McPhee is an acknowledged expert on the important ocean boundary layer beneath sea ice. His book, which ties together almost four decades of research, details the current understanding of how the shallowest water layers and wind-forced sea ice interact and how that interaction can be modeled numerically. The range of topics