QUANTUM MEASUREMENT AND CONTROL

The control of individual quantum systems promises a new technology for the twenty-first century – quantum technology. This book is the first comprehensive treatment of modern quantum measurement and measurement-based quantum control, which are vital elements for realizing quantum technology.

Readers are introduced to key experiments and technologies through dozens of recent experiments in cavity QED, quantum optics, mesoscopic electronics and trapped particles, several of which are analysed in detail. Nearly 300 exercises help build understanding, and prepare readers for research in these exciting areas.

This important book will interest graduate students and researchers in quantum information, quantum metrology, quantum control and related fields. Novel topics covered include adaptive measurement; realistic detector models; mesoscopic current detection; Markovian, state-based and optimal feedback; and applications to quantum information processing.

HOWARD M. WISEMAN is Director of the Centre for Quantum Dynamics at Griffith University, Australia. He has worked in quantum measurement and control theory since 1992, and is a Fellow of the Australian Academy of Science (AAS). He has received the Bragg Medal of the Australian Institute of Physics, the Pawsey Medal of the AAS and the Malcolm Macintosh Medal of the Federal Science Ministry.

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An outstanding introduction, at the advanced graduate level, to the mathematical description of quantum measurements, parameter estimation in quantum mechanics, and open quantum systems, with attention to how the theory applies in a variety of physical settings. Once assembled, these mathematical tools are used to formulate the theory of quantum feedback control. Highly recommended for the physicist who wants to understand the application of control theory to quantum systems and for the control theorist who is curious about how to use control theory in a quantum context.

Carlton Caves, University of New Mexico

A comprehensive and elegant presentation at the interface of quantum optics and quantum measurement theory. Essential reading for students and practitioners, both, in the growing quantum technologies revolution.

Howard Carmichael, The University of Auckland

Quantum Measurement and Control provides a comprehensive and pedagogical introduction to critical new engineering methodology for emerging applications in quantum and nano-scale technology. By presenting fundamental topics first in a classical setting and then with quantum generalizations, Wiseman and Milburn manage not only to provide a lucid guide to the contemporary toolbox of quantum measurement and control but also to clarify important underlying connections between quantum and classical probability theory. The level of presentation is suitable for a broad audience, including both physicists and engineers, and recommendations for further reading are provided in each chapter. It would make a fine textbook for graduate-level coursework.

Hideo Mabuchi, Stanford University

This book present a unique summary of the theory of quantum measurements and control by pioneers in the field. The clarity of presentation and the varied selection of examples and exercises guide the reader through the exciting development from the earliest foundation of measurements in quantum mechanics to the most recent fundamental and practical developments within the theory of quantum measurements and control. The ideal blend of precise mathematical arguments and physical explanations and examples reflects the authors' affection for the topic to which they have themselves made pioneering contributions.

Klaus Mølmer, University of Aarhus

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To our boys: Tom & Andy, Finlay & Bailey,
who were much smaller when we began.