OPTICAL MAGNETOMETRY

Featuring chapters written by leading experts in magnetometry, this book provides comprehensive coverage of the principles, technology, and diverse applications of optical magnetometry, from testing fundamental laws of nature to detecting biomagnetic fields and medical diagnostics.

Readers will find a wealth of technical information, from antirelaxation-coating techniques, microfabrication, and magnetic shielding to geomagnetic-field measurements, space magnetometry, detection of biomagnetic fields, detection of NMR and MRI signals, and rotation sensing. The book includes an original survey of the history of optical magnetometry, and a chapter on the commercial use of these technologies.

The book is supported by extensive online material, containing historical overviews, derivations, side-line discussion, and additional plots and tables, available at www.cambridge.org/9781107010352. As well as introducing graduate students to this field, the book is also a useful reference for researchers in atomic physics.

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Preface

Optical magnetometry, in which a magnetic field is measured by observing changes in the properties of light interacting with matter immersed in the field, is not a new field. It has its origins in Michael Faraday's discovery in 1845 of the rotation of the plane of linearly polarized light as it propagated through a dense glass in the presence of a magnetic field. Faraday's historic discovery marked the first experimental evidence relating light and electromagnetism.

A century later, atomic magnetometers based on optical pumping were introduced and gradually perfected by such giants as Alfred Kastler, Hans Dehmelt, Jean Brossel, William Bell, Arnold Bloom, and Claude Cohen-Tannoudji, to name but a few of the pioneers. Recent years have seen a revolution in the field related to the development of tunable diode lasers, efficient antirelaxation wall coatings, techniques for elimination of spin-exchange relaxation, and, most recently, the advent of optical magnetometers based on color centers in diamond. Today, optical magnetometers are pushing the boundaries of sensitivity and spatial resolution, and, in contrast to their able competition from superconducting quantum interference device (SQUID) magnetometers, they do not require cryogenic temperatures. Numerous novel applications of optical magnetometers have flourished, from detecting signals in microfluidic nuclear-magnetic resonance chips to measuring magnetic fields of the human brain to observing single nuclear spins in a solid matrix.

The remarkable progress of optical magnetometry during recent years called for a single-source reference to help those entering the field, including students and practitioners interested in applications, to get a "jump-start" on the principles, techniques, conventions, and the latest achievements. Toward this goal, we have assembled a remarkable group of authors, who have teamed up to prepare twenty pedagogical chapters packed with information. We are excited to offer the result of this effort for the perusal and judgement of the reader. Of course, we welcome and appreciate feedback on the content of the book, which can be sent to us via e-mail (dbudker@gmail.com or derek.jacksonkimball@csueastbay.edu). Please note that the book web site www.cambridge.org/9781107010352 is a repository for additional material related to the subjects discussed in the chapters.

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