In recent years, Rydberg atoms have been the subject of intense study, becoming the testing ground for several quantum mechanical problems. This book provides a comprehensive description of the physics of Rydberg atoms, highlighting their remarkable properties by reference to their behavior in a wide range of physical situations.

Beginning with a brief historical overview, the basic properties, creation and detection of Rydberg atoms are described. The effects of blackbody radiation are discussed, as are optical excitation in static electric fields, ionization by pulsed electric fields, Rydberg spectroscopy in high magnetic fields, and microwave excitation and ionization. The collisions of Rydberg atoms with neutral atoms and molecules, charged particles, and other Rydberg atoms are dealt with in detail. The powerful method of multichannel quantum defect theory is presented, and used in the description of autoionizing Rydberg states, interseries interactions and double Rydberg states.

In addition to providing a clear introduction to the basic properties of Rydberg atoms, experimental and theoretical research in this extensive field is reviewed. The books will therefore be valuable to both graduate students and established researchers in physics and physical chemistry.

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CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press
The Edinburgh Building, Cambridge CB2 2RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org
Information on this title: www.cambridge.org/9780521385312

First published 1994
This digitally printed first paperback version 2005

A catalogue record for this publication is available from the British Library

Library of Congress Cataloguing in Publication data

Gallagher, Thomas F.
Rydberg atoms / Thomas F. Gallagher.
p. cm.
ISBN 0-521-38531-8
1. Rydberg states. I. Title.
QC454.A8S27 1994
539.7—dc20 93-37132 CIP

ISBN-13 978-0-521-38531-2 hardback
ISBN-10 0-521-38531-8 hardback

ISBN-13 978-0-521-02166-1 paperback
ISBN-10 0-521-02166-9 paperback

Contents

Preface

My intent in writing this book is to present a unified description of the many properties of Rydberg atoms. It is intended for graduate students and research workers interested in the properties of Rydberg states of atoms or molecules. In many ways it is similar to the excellent volume *Rydberg States of Atoms and Molecules* edited by R. F. Stebbings and F. B. Dunning just over a decade ago. It differs, however, in covering more topics and in being written by one author. I have attempted to focus on the essential physical ideas. Consequently the theoretical developments are not particularly formal, nor is there much emphasis on the experimental details.

The constraints imposed by the size of the book and my energy have forced me to limit the topics covered in this book to those of general interest and those about which I already knew something. Consequently, several important topics which might well have been included by another author are not included in the present volume. Two examples are molecular Rydberg states and cavity quantum electrodynamics.

Finally, it is a great pleasure to acknowledge the fact that this book would never have been written without the efforts of many people. First I would like to acknowledge the help of my colleagues in the Molecular Physics Laboratory of SRI International (originally Stanford Research Institute). They had the confidence that our initial experiments would develop into a productive research program, and they completed my education as a physicist. My colleagues at the University of Virginia have continued to provide both a critical audience and the encouragement necessary to undertake the writing of this book.

My collaborators have contributed substantially to my understanding of Rydberg atoms, and it is a pleasure to acknowledge the contributions of L. A. Bloomfield, W. E. Cooke, S. A. Edelstein, F. Gounand, R. M. Hill, R. Kachru, R. R. Jones, D. J. Larson, D. C. Lorents, L. Noordam, P. Pillet, K. A. Safinya, W. Sandner, and R. C. Stoneman. In addition I have been the beneficiary of the insights of my students, post doctoral fellows, and visitors. Without all of their contributions this book could not have been written.

I am indebted to Tammie Shifflett, Bessie Truzy, Warrick Liu, and Sibyl Hale for their careful typing of the manuscript, and it is a pleasure to acknowledge the encouragement of James Deeny, Rufus Neal, and Philip Meyler of the Cambridge

University Press. Finally, the gentle prodding of my mother, Margaret Gallagher, and the patience of my wife, Betty, played important roles in the completion of this book.

Charlottesville, Virginia *T. F. Gallagher*
November, 1993