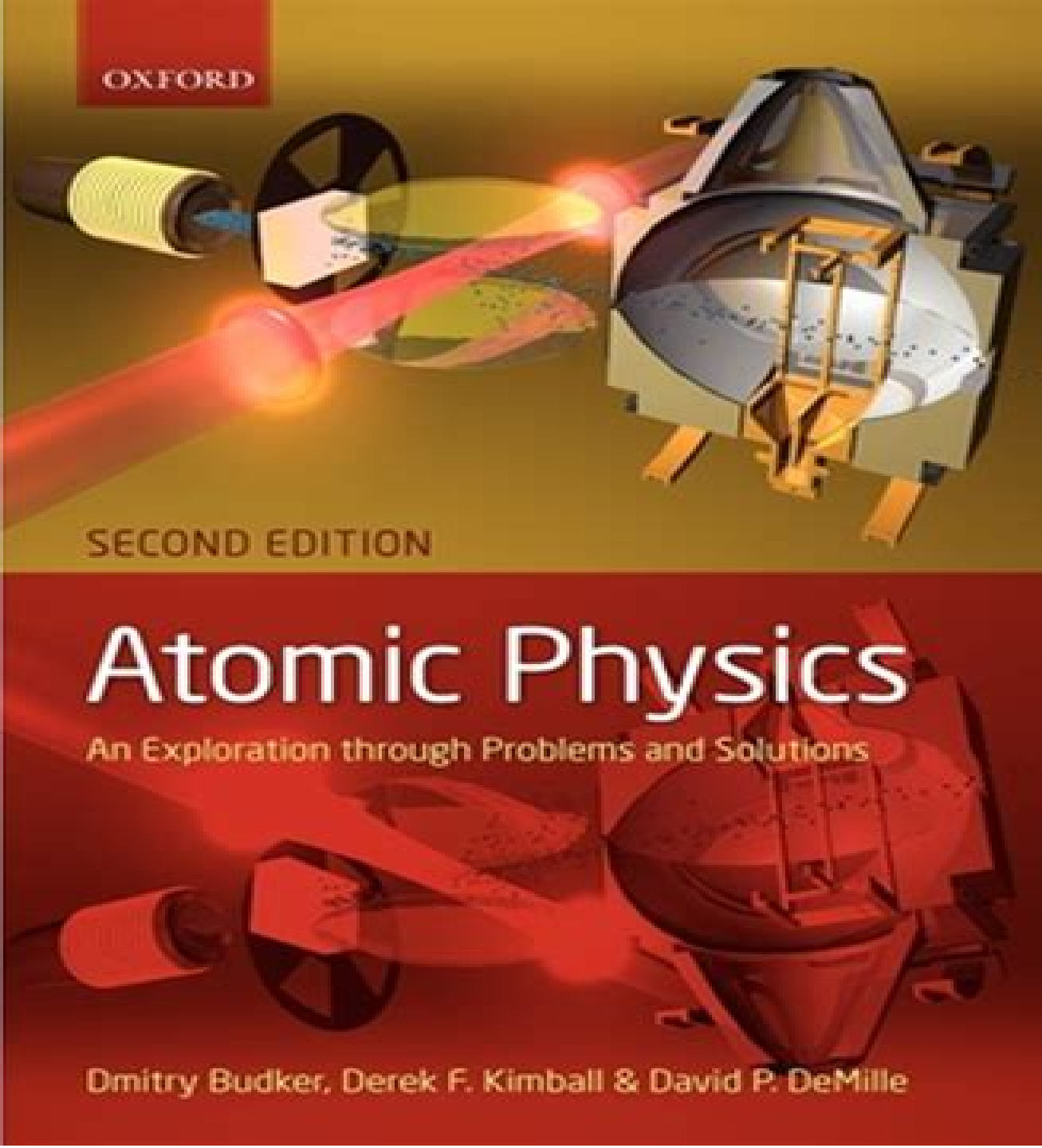


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Atomic Physics

An Exploration through Problems and Solutions

Dmitry Budker, Derek F. Kimball & David P. DeMille

Atomic Physics An Exploration Through Problems And Solutions

**Dmitry Budker, Derek F. Kimball, David
P. DeMille**



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Principles of Laser Spectroscopy and Quantum Optics Paul R. Berman, Vladimir S. Malinovsky, 2011-01-02 Principles of Laser Spectroscopy and Quantum Optics is an essential textbook for graduate students studying the interaction of optical fields with atoms It also serves as an ideal reference text for researchers working in the fields of laser spectroscopy and quantum optics The book provides a rigorous introduction to the prototypical problems of radiation fields interacting with two and three level atomic systems It examines the interaction of radiation with both atomic vapors and condensed matter systems the density matrix and the Bloch vector and applications involving linear absorption and saturation spectroscopy Other topics include hole burning dark states slow light and coherent transient spectroscopy as well as atom optics and atom interferometry In the second half of the text the authors consider applications in which the radiation field is quantized Topics include spontaneous decay optical pumping sub Doppler laser cooling the Heisenberg equations of motion for atomic and field operators and light scattering by atoms in both weak and strong external fields The concluding chapter offers methods for creating entangled and spin squeezed states of matter Instructors can create a one semester course based on this book by combining the introductory chapters with a selection of the more advanced material A solutions manual is available to teachers Rigorous introduction to the interaction of optical fields with atoms Applications include linear and nonlinear spectroscopy dark states and slow light Extensive chapter on atom optics and atom interferometry Conclusion explores entangled and spin squeezed states of matter Solutions manual available only to teachers

Magnetically Activated and Guided Isotope Separation Thomas R. Mazur, 2015-11-19 This thesis describes a proof of principle experiment demonstrating a technique for stable isotope enrichment called Magnetically Activated and Guided Isotope Separation MAGIS Over the past century many enriched isotopes have become available thanks largely to electromagnetic separators called calutrons Due to substantial maintenance and operating costs the United States decommissioned the last of its calutrons in 1998 leading to demand for alternative methods of isotope separation The work presented here suggests the promise for MAGIS as a viable alternative to the calutrons The MAGIS technique combines

optical pumping with a scalable magnetic field gradient to enrich atoms of a specific isotope in an atomic beam Benchmarking this work against the calutron using lithium as a test case the author demonstrated comparable enrichment in a manner that should scale to the production of similar quantities while requiring vastly less energy input

Lectures on Analytical Mechanics G. L. Kotkin, V. G. Serbo, A. I. Chernykh, 2024-03-20 Written by professional physicists with over 140 years of teaching experience combined this book is aimed at students and lecturers in physics The authors present analytical mechanics as the basis for the study of theoretical physics its methods and ideas forming the foundation of all other branches including quantum mechanics statistical physics and field theory The book begins by discussing the motion of particles in a central field and scattering of particles based on Newton's equations It then introduces and explores Lagrange equations for various systems linear and non linear oscillations Hamiltonian formalism and the motion of a rigid body Each topic is accompanied by problems that are suitable for seminars and testing The book also includes five supplemental sections which provide practical illustrations of the theoretical material These sections can be used by teachers as the basis for conducting a specialized course or by curious students who wish to explore different applications of analytical mechanics independently

An Introduction to Quantum Optics and Quantum Fluctuations Peter W. Milonni, 2019 This is an introduction to the quantum theory of light and its broad implications and applications A significant part of the book covers material with direct relevance to current basic and applied research such as quantum fluctuations and their role in laser physics and the theory of forces between macroscopic bodies Casimir effects The book includes numerous historical sidelights throughout and approximately seventy exercises The book provides detailed expositions of the theory with emphasis on general physical principles Foundational topics in classical and quantum electrodynamics are addressed in the first half of the book including the semiclassical theory of atom field interactions the quantization of the electromagnetic field in dispersive and dissipative media uncertainty relations and spontaneous emission The second half begins with a chapter on the Jaynes Cummings model dressed states and some distinctly quantum mechanical features of atom field interactions and includes discussion of entanglement the no cloning theorem von Neumann's proof concerning hidden variable theories Bell's theorem and tests of Bell inequalities The last two chapters focus on quantum fluctuations and fluctuation dissipation relations beginning with Brownian motion the Fokker Planck equation and classical and quantum Langevin equations Detailed calculations are presented for the laser linewidth spontaneous emission noise photon statistics of linear amplifiers and attenuators and other phenomena Van der Waals interactions Casimir forces the Lifshitz theory of molecular forces between macroscopic media and the many body theory of such forces based on dyadic Green functions are analyzed from the perspective of Langevin noise vacuum field fluctuations and zero point energy

Measuring Fundamental Symmetry Violation in Polyatomic Molecules Arian Jadbabaie, 2025-06-16 This thesis presents major advances toward the realization of quantum control in complex molecules for applications in precision metrology Polyatomic molecules engineered to be sensitive to new

fundamental particles and forces are a powerful platform to search for physics beyond the Standard Model A major limitation to this application as well as any other relying on the complete quantum control of complex polyatomic molecules is that fully understanding them remains a research frontier This thesis represents several major steps toward the goal of quantum control in complex molecules including tailored laser driven chemistry to enhance their production high resolution spectroscopy to understand their structure including the critical role of symmetry and successful implementation of coherent quantum control This thesis lays the foundation for fundamental studies in nuclear physics particle physics and physical chemistry using engineered quantum controlled molecules

Pushing The Frontiers Of Atomic Physics - Proceedings Of The Xxi International Conference On Atomic Physics Winthrop W Smith, Robin Cote, Phillip L Gould, Michael G Rozman, Pierre Agostini, 2009-03-12 This unique book highlights the state of the art of the booming field of atomic physics in the early 21st century It contains the majority of the invited papers from an ongoing series of conferences held every two years devoted to forefront research and fundamental studies in basic atomic physics broadly defined This conference held at the University of Connecticut in July 2008 is part of a series of conferences which began in 1968 and had its historical origins in the molecular beam conferences of the I I Rabi group It provides an archival and up to date summary of current research on atoms and simple molecules as well as their interactions with each other and with external fields including degenerate Bose and Fermi quantum gases and interactions involving ultrafast lasers strong field control of X ray processes and nanoscale and mesoscopic quantum systems The work of three recent Nobel Laureates in atomic physics is included beginning with a lecture by Eric Cornell on When Is a Quantum Gas a Quantum Liquid There are also papers by Laureates Steven Chu and Roy Glauber The volume also contains the IUPAP Young Scientist Prize lecture by Cheng Chin on Exploring Universality of Few Body Physics Based on Ultracold Atoms Near Feshbach Resonances

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