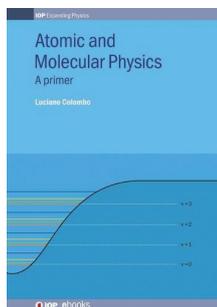


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LUCIANO COLOMBO

ATOMIC AND MOLECULAR PHYSICS A PRIMER

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The academic activity of Luciano Colombo may be summarized in the concept “no good research without teaching, no good teaching without research”. His widely recognized work in condensed matter theoretical physics goes together with a highly appreciated teaching in the areas of structure of matter and materials physics, which took shape in some textbooks in Italian like *Fisica dei Semiconduttori* (Zanichelli, 2018, reviewed in *Il Nuovo Saggiatore*, vol. 34, n. 5-6 (2018)), *Introduzione alla Teoria dell'Elasticità*, coauthored with Stefano Giordano (Springer 2007, reviewed in *Il Nuovo Saggiatore*, vol. 23, n. 5-6 (2007)) and *Elementi di Struttura della Materia* (Hoepli 2002, reviewed in *Il Nuovo Saggiatore*, vol. 19, n. 1-2 (2003)). We can trace back to this early experience, enriched by two decades of valuable teaching, the present *Primer* and the next two on solid-state and statistical physics, which will follow within a new IOPP editorial project.

This *Primer* is organized in four parts on Preliminary Concepts, Atomic Physics, Molecular Physics, and Concluding remarks. While the parts on atomic and molecular physics cover the essential topics of standard textbooks (one-electron atoms, their interaction with radiation, multi-electron atoms; the molecular bonding, molecular rotations, vibrations and electronic structure), the introductory part is where the pedagogical approach is best appreciated. Here the section devoted to the *overall picture* guides the reader through the crucial experimental and theoretical facts that historically helped developing first the atomistic view of ordinary matter, then quantum mechanics up to the constitutive equation for matter waves. The second section provides the student with the essential concepts of quantum mechanics.

Although these preliminary concepts may seem to be conceived for a wider audience than that of physics students, who undertake the study of atomic and molecular physics after a comprehensive course in quantum mechanics, their tutorial style helps

appreciating the essential, fundamental reasons that enforced the transition from the classical to the quantum-mechanical picture of the microscopic world. As such, readers from all scientific disciplines will enjoy and greatly profit from this *Primer*. As remarked by Enric Canadell in his *Foreword*, “the gift to be able to explain complex concepts in simple words is the result of long practice in polishing from unnecessary complications and reducing the problem to their very fundamental nature. Professor Colombo is an accomplished communicator as any reader of this book will agree”. It is here worth mentioning that with the recent updating of the physics programs in Italian high schools with the inclusion of basic notions of quantum mechanics, a corresponding updating of high-school professors is needed. To this purpose, a series of lectures organized by the Istituto Lombardo – Accademia di Scienza e Lettere in Milan and delivered by our author have been very well received. Very likely also this experience has contributed to the pedagogical quality of this *Primer*. On the other hand, the research work, consisting in the daily use of quantum mechanics for quantum molecular dynamics and simulation of materials is well reflected in the clear illustration of atomic (Part II) and molecular physics (Part III).

The concluding remarks (Part IV) is actually a list of 14 more advanced subjects which are missing in this *Primer*, and can however be found in the specific textbooks cited in the essential literature at the end of each chapter. Finally the technical aspects and the mathematics involved in the basic quantum theory of atoms and molecules are described in a series of eight clear appendices. We are looking forward to the next two textbooks, respectively on solid state physics and statistical physics, – the natural follow-ups to this excellent *Primer*.

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