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Review of *Atoms and Molecules* by M. Weissbluth

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Atoms and Molecules (Student Edition)

M. Weissbluth
713 pp. Academic, New York, 1978. $24.50

The advent of high-powered lasers and of dedicated synchrotron light sources and the needs of research in such areas as astrophysics and fusion have led to a resurgence of interest in atomic and molecular physics. Concurrently, there have been significant advances in atomic and molecular theory, not only in the ability to make more reliable numerical predictions but also in the detailed understanding of the dynamics of atomic and molecular collisions. The nonspecialist or beginning graduate student who must read the scientific journals to learn of these advances often finds that the requisite basic knowledge is extensive. Mitchel Weissbluth, whose book has just been published in a paperback edition, intended to meet the basic needs of such a graduate student. As stated in the Preface, the book is an outgrowth of a one-year course in atomic and molecular physics in the department of applied physics at Stanford University for students who came from such diverse fields as spectroscopy, magnetic resonance, Mössbauer resonance, quantum electronics, solid-state electronics, astrophysics and biological physics. The book aims, and largely succeeds, in providing a good grounding in atomic and molecular structure and spectra using the modern analytical tools of tensor algebra and group theory.

Before discussing atoms and molecules, Weissbluth presents two very tersely written sections of necessary background material. The first provides the mathematical background on angular momentum, group theory, tensor algebra and vector fields, and the second gives the quantum mechanical background: symmetry properties, time dependence, Slater determinants, second quantization and density matrices. The discussion of atoms starts in the third part, which is concerned with one-electron atoms. Weissbluth interestingly starts with the Dirac equation and proceeds to its nonrelativistic approximation, thereby obtaining in the simplest way all of the interaction terms that are important in atomic physics. This part also includes the hydrogen atom, electric and magnetic fields, and hyperfine interactions. Part IV is concerned with N-electron atoms, including the Hartree–Fock approximation. Electromagnetic absorption and emission processes in atoms are the subject of Part V. Finally, Part VI provides an excellent brief introduction of molecular structure and spectra.

The background material, in Parts I and II, is probably too compactly written to be used in textbook fashion and includes no problems and too few examples. It does serve as a valuable summary, however, for the more experienced reader as well as for the lecturer. Weissbluth has written the parts of the book on atoms and molecules, on the other hand, in a more leisurely style. They are appropriate for a solid course on atomic and molecular structure even though they do not go into the depth required to satisfy the needs of researchers. In particular, only the simplest approximation methods for atomic and molecular wave functions are discussed, collision processes are omitted altogether, and no attempt to compare theoretical results with experiment is made. However, these are the criticisms of a researcher. Students will like this book, and their advisers and lecturers will be grateful that a book such as this exists to be recommended to them.

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