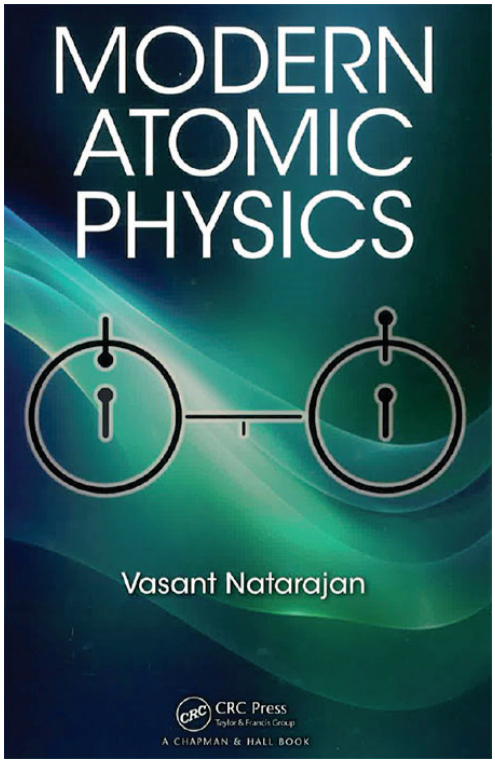
Book Review



MODERN ATOMIC PHYSICS by Vasant Natarajan Published by CRC Press (New York), Pages 418, Hardbound Rs 4514 (GBP 63.99) from Amazon.

"Modern Atomic Physics" by Vasant Natarajan, is an excellent book on various atomic processes and spectroscopy for advanced graduate students.

The book contains eleven chapters building up from harmonic oscillator, coherent states, squeezed states and radiation in preliminaries and ending with multiphoton processes, line shapes, spectroscopy and cooled atoms. Each chapter has a set of problems with solutions. A list of abbreviations is provided at the beginning of the book. Various concepts have been presented in the Appendix which is located before the index.

In the first chapter (Metrology) the author takes up the science of measurement, where he brushes up on various units and fundamental constants. Apart from SI, the author discusses universal units and atomic units.

In the second chapter (Preliminaries) the author discusses classical harmonic oscillator, harmonically bound electron, classical coupled oscillators. He then goes on to quantum mechanical treatment of harmonic oscillator discussing coherent states and squeezed states (including generation of squeezed light). He then discusses radiation from Maxwell's equations, to quantization and Casimir effect.

In the third chapter the author discusses the quantum mechanical description of the one electron atom and its interaction with electromagnetic fields (from static fields to weak oscillatory fields, to strong oscillatory fields).

In the fourth chapter the author discusses the effect of the nucleus with respect to the electronic energy states. The effect of nuclear multipole and isotopes and are discussed here.

In the fifth chapter, the author discusses resonance, classically (Larmor's theorem) and quantum mechanically (Pauli spin matrices, Rabi transition probability, resonance in a two-state system and density matrix theory).

In the sixth chapter a semiclassical interaction of the atom with electromagnetic radiation is discussed. Selection rules for electronic transitions, transition rates, spontaneous emission and saturation intensities are discussed here.

In the seventh chapter the author presents multiphoton processes. The author covers two-photon absorption, transition rates, stimulated emission, stimulated and spontaneous Raman scattering in this chapter.

In the eighth chapter the author discusses coherence. Here he discusses coherence in single atoms, quantum beats, level crossing and coherence in localized and extended ensembles. Here the author discusses coherent population trapping (CPT) and electromagnetically induced transparency (EIT).

The ninth chapter is on line shapes. Here the author discusses line broadening, the Lorentzian shape, spontaneous decay line shape, relativistic (photon recoil) and Doppler shifts, line shapes of atoms in a gas and line shapes for confined particles (recoilless emission, Dicke narrowing, etc.). He also touches on Gaussian beam optics here.

Spectroscopy is introduced in the tenth chapter where various experimental methods are discussed. The author also discusses Doppler-free techniques and nonlinear magneto-optic rotation (NMOR) in this chapter.

Cooling and trapping of atoms are discussed in the eleventh chapter. Here Doppler cooling, polarization gradient cooling, magneto-optic trap, *Zeeman slower* and *atomic fountain* are discussed under spontaneous force cooling section. Dipole trap is discussed under stimulated force. Evaporative cooling, Bose condensation, optical tweezers and other ion traps are also discussed here.

In the appendix the author discusses various issues from measurement standards to some very interesting discussion of the concept of the photon and the case of the stimulated radiation. Studying the Gravitational red-shift and production of the frequency comb is discussed in brief here.

As mentioned before, this book is for the advanced graduate students and as a handbook for specialists in the area of atomic physics and spectroscopy. The book covers contemporary work in this area and is very informative. ❐

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