

M. Saffman
Ph 545 Introduction to Atomic Structure
2017.09.06

Atomic Physics Books (* = book on reserve in Physics library)

E. B. Alexandrov, M. P. Chaika, and G. I. Khvostenko, *Interference of atomic states*, (Springer, Berlin, 1993).

N. Andersen and K. Bartschat, *Polarization, Alignment and Orientation in Atomic Collisions*, (Springer, Berlin, 2001).

A. V. Andreev, *Atomic spectroscopy, Introduction to the theory of hyperfine structure*, (Springer, Berlin, 2006).

L. Armstrong, Jr., *Theory of the hyperfine structure of free atoms*, (Wiley, New York, 1971).
Detailed treatment of hyperfine interactions.

M. Auzinsh, D. Budker, and S. M. Rochester, *Optically Polarized Atoms: Understanding light-atom interactions*, (Oxford University Press, Oxford, 2010).

J. Avery and J. Avery, *Generalized Sturmians and Atomic Spectra*, (World Scientific, 2006).
Alternative formalism for treating many electron atoms.

P. F. Bernath, *Spectra of atoms and molecules, 2nd Ed.*, (Oxford University Press, Oxford, 2005).

K. D. Bonin and V. V. Kresin, *Electric-dipole polarizabilities of atoms, molecules and clusters*, (World Scientific, Singapore, 1997).

R. Boudet, *Relativistic Transitions in the Hydrogenic Atoms: Elementary Theory*, (Springer, Berlin, 2010).

B. H. Bransden and C. J. Joachain, *Physics of atoms and molecules, 2nd Ed.*, (Pearson, Harlow, 2003).
Comprehensive and modern treatment. Includes much material on atomic collisions and molecular structure.

* D. Budker, D. F. Kimball, and D. P. DeMille, *Atomic physics an exploration through problems and solutions, 2nd ed.*, (Oxford University Press, Oxford, 2008).
Atomic physics through problem solving. Treats many current research topics.

C. Cohen-Tannoudji and D. Guéry-Odelin, *Advances in Atomic Physics, an overview*, (World Scientific, Singapore, 2011).
Excellent and detailed presentation of much of the most exciting atomic physics research of the last several decades.

E. U. Condon and H. Odabasi, *Atomic structure*, (Cambridge University Press, Cambridge, 1980).

J.-P. Connerade, *Highly-excited atoms*, (Cambridge University Press, Cambridge, 1998).

A. Corney, *Atomic and laser spectroscopy*, (Clarendon Press, Oxford, 1977).

R. D. Cowan, *The Theory of Atomic Structure and Spectra*, (University of California Press, 1981).
Detailed treatment of calculation techniques for complex spectra

L. J. Curtis, *Atomic Structure and Lifetimes: A Conceptual Approach*, (Cambridge University Press, Cambridge, 2003).
semiclassical approach to atomic physics

- N. B. Delone and V. P. Krainov, *Atoms in strong light fields*, (Springer, Berlin, 1985).
- W. Demtröder, *Atoms, molecules and photons: An introduction to atomic, molecular, and quantum physics*, (Springer, Berlin, 2006).
- A. B. F. Duncan, *Rydberg series in atoms and molecules*, (Academic Press, New York 1971).
- U. Fano and L. Fano, *Physics of atoms and molecules; an introduction to the structure of matter*, (University of Chicago Press, Chicago, 1972).
- U. Fano and G. Racah, *Irreducible Tensorial Sets*, (Academic press, New York, 1959).
Advanced treatment of angular momentum algebra.
- U. Fano and A. R. P. Rau, *Atomic collisions and spectra*, (Academic Press, Orlando, 1986).
- * C. Foot, *Atomic physics*, (Oxford University Press, Oxford, 2004).
Written by an experimentalist, with applications to modern topics such as laser cooling and quantum computing.
- H. Friedrich, *Theoretical atomic physics, 3rd Ed.*, (Springer, Berlin, 2006).
Includes multichannel quantum defect theory, and calculational techniques for complex spectra.
- C. Froese-Fischer, T. Brage, and P. Jonsson, *Computational Atomic Structure: An MCHF Approach*, (Institute of Physics, London, 2000).
- T. F. Gallagher, *Rydberg atoms*, (Cambridge University Press, Cambridge, 1994).
Comprehensive treatment of highly excited Rydberg atoms.
- I. P. Grant, *Relativistic Quantum Theory of Atoms and Molecules*, (Springer, Berlin, 2007).
- H. Haken and H. C. Wolf, *The physics of atoms and quanta, 6th Ed.*, (Springer, Berlin, 2000).
Pedagogical and modern treatment. Some additional topics, but less detail compared to Woodgate.
- W. Happer, Y.-Y. Jau, and T. G. Walker, *Optically pumped atoms*, (Wiley-VCH, Weinheim, 2010).
Detailed coverage of optical pumping, uses non-standard notation.
- I. V. Hertel and C.-P. Schulz, *Atoms, molecules, and optical physics 1. Atoms and spectroscopy*, (Springer, Berlin, 2015).
- M. Inguscio and L. Fallani, *Atomic physics: Precise measurements and ultracold matter*, (Oxford University Press, Oxford, 2013).
- C. J. Joachain, N. J. Kylstra, and R. M. Potvliege, *Atoms in intense laser fields*, (Cambridge University Press, Cambridge, 2012).
- W. R. Johnson, *Atomic structure theory* (Springer, Berlin, 2007).
Advanced level, including numerical techniques.
- B. R. Judd, *Operator techniques in atomic spectroscopy*, (Princeton University Press, Princeton, 1998),
Advanced treatment of group theoretical methods.
- B. R. Judd and J. P. Elliott, *Topics in atomic and nuclear theory*, (Caxton press, Christchurch, 1970)

- V. P. Krainov, H. Reiss, and B. M. Smirnov, *Radiative processes in atomic physics*, (Wiley, New York, 1997).
- H. G. Kuhn, *Atomic spectra*, 2nd Ed. , (Longmans, Green, & Co. Ltd., London, 1969).
- L. N. Labzowsky, G. L. Klimchirskaya, and Yu Yu Dmitriev, *Relativistic Effects in the Spectra of Atomic Systems*, (Institute of Physics Publishing, Bristol, 1993).
- L. D. Landau and E. M. Lifshitz, *Quantum Mechanics non-relativistic theory*, 2nd Ed. , (Pergamon, Oxford, 1965). Includes much detail on the Hydrogen atom, angular momentum algebra, and collision theory.
- V. B. Berestetskii, E. M. Lifshitz, and L. P. Pitaevskii, *Relativistic quantum theory, Part 1 (Volume 4, Part 1 of Landau and Lifshitz)*, (Pergamon, Oxford, 1971).
Contains an excellent treatment of the interaction of atoms with radiation fields
- I. Lindgren and J. Morrison, *Atomic Many-Body Theory, 2nd Ed.*, (Springer, Berlin, 1985).
Good reference for diagrammatic method in angular momentum calculations.
- I. Lindgren, *Relativistic Many-Body Theory, A new field theoretical approach*, (Springer, New York, 2011).
- M. H. Mittleman, *Introduction to the theory of laser-atom interactions, 2nd Ed.*, (Plenum Press, New York, 1993).
- B. Narayan, *Fundamentals of spectroscopy*, (Allied Publishers, Mumbai, 1999).
- V. Natarajan, *Modern atomic physics*, (CRC Press, Boca Raton, 2015).
- Z. Rudzikas, *Theoretical atomic spectroscopy*, (Cambridge University Press, Cambridge, 1997).
Advanced treatment of many electron atoms.
- V. P. Shevelko, *Atoms and Their Spectroscopic Properties*, (Springer, Berlin, 1997).
- B. M. Smirnov, *Physics of atoms and ions*, (Springer, New York, 2003).
Intermediate level treatment, much material on collision processes.
- B. W. Shore and D. H. Menzel, *Principles of atomic spectra* (John Wiley and Sons, Inc., New York, 1968).
- B. W. Shore, *The theory of coherent atomic excitation. Volume 1 simple atoms and fields* (John Wiley and Sons, Inc., New York, 1990).
- B. W. Shore, *The theory of coherent atomic excitation. Volume 2 multilevel atoms and incoherence* (John Wiley and Sons, Inc., New York, 1990).
- B. W. Shore, *Manipulating quantum structures using laser pulses* (Cambridge University Press, Cambridge, 2011).
- M. P. Silverman, *Probing the atom*, (Princeton University Press, Princeton, 2000).
- * I. I. Sobelman, *Atomic spectra and radiative transitions, 2nd Ed.* (Springer, Berlin, 1992).
Good reference volume.
- I. I. Sobelman, *Theory of atomic spectra* (Alpha Science International, Oxford, 2006).
Slightly updated version of the preceding book.
- I. I. Sobelman, L. A. Vainshtein, and E. A. Yukov, *Excitation of Atoms and Broadening of Spectral Lines* (Springer,

Berlin, 1995)

T. P. Softley, *Atomic spectra* (Oxford University Press, Oxford, 1994).

R. F. Stebbings and F. B. Dunning, Editors, *Rydberg states of atoms and molecules* (Cambridge University Press, Cambridge, 1983).

S. Svanberg, *Atomic and Molecular Spectroscopy: Basic Aspects and Practical Applications, 4th Ed.* (Springer, Berlin, 2004).

W. Thirring, *Quantum Mathematical Physics, Atoms, Molecules, and Large Systems, 2nd Ed.* (Springer, Berlin, 2002).

sophisticated mathematical treatment

A. Thorne, U. Litzén, and S. Johansson, *Spectrophysics: Principles and Applications* (Springer, Berlin, 1999).

* P. van der Straten and H. Metcalf, *Atoms and Molecules interacting with light*, (Cambridge University Press, Cambridge, 2016).

J. Vanier and C. Tomescu, *The Quantum Physics of Atomic Frequency Standards: Recent Developments* (CRC Press, Boca Raton, 2016).

M. Weissbluth, *Atoms and molecules, 2nd Ed.*, (Academic, New York, 1978).

Good reference work. Much detail on group theory and angular momentum calculations.

* G. K. Woodgate, *Elementary atomic structure, 2nd Ed.*, (Clarendon Press, Oxford, 1998).

Secondary reference, class text in previous years.

B. G. Wybourne, *Spectroscopic properties of rare earths*, (Interscience, New York, 1965).

Advanced treatment of rare earth elements

B. G. Wybourne, *Symmetry principles and atomic spectroscopy*, (Wiley-Interscience, New York, 1970).

Advanced treatment

B. G. Wybourne and L. Smentek, *Optical Spectroscopy of Lanthanides: Magnetic and Hyperfine Interactions*, (CRC Press, Boca Raton, 2007).

Older texts

* H. A. Bethe and E. E. Salpeter, *Quantum mechanics of one- and two-electron atoms*, (Plenum, New York, 1977).
Authoritative account of the Hydrogen atom. Includes Dirac theory and radiative corrections.

* M. Born, *Atomic physics, 8th Ed.*, (Dover, New York, 1969).

Covers a wealth of material. Excellent reference.

E. U. Condon and G. H. Shortley, *The theory of atomic spectra*, (Cambridge, Cambridge, 1951).

This is a classic. Advanced treatment of atomic structure.

G. Herzberg, *Atomic spectra and atomic structure, 2nd Ed.*, (Dover, New York, 1944).

Good introductory treatment

W. R. Hindmarsh, *Atomic spectra*, (Pergamon, Oxford, 1967).
Concise introduction as well as a collection of translations of classic papers.

J. C. Slater, *Quantum theory of atomic structure, Vols. I & II*, (McGraw-Hill, New York, 1960)
Comprehensive treatment of quantum mechanics and applications to atoms. Includes extensive bibliographies.

Collision theory

N. Andersen and K. Bartschat, *Polarization, alignment, and orientation in atomic collisions*, (Springer, New York, 2001).

P. G. Burke, *R-Matrix theory of atomic collisions*, (Springer, Berlin, 2011).

I. E. McCarthy and E. Weigold, *Electron-atom collisions*, ((Cambridge University Press, Cambridge, 1995).

J. H. McGuire, *Electron correlation dynamics in atomic collisions*, ((Cambridge University Press, Cambridge, 1997).

J. Weiner, *Cold and Ultracold Collisions in Quantum Microscopic and Mesoscopic Systems*, ((Cambridge University Press, Cambridge, 2003).

Angular momentum theory

L. C. Biedenharn and J. D. Louck, *Angular momentum in quantum physics*, (Cambridge University Press, Cambridge, 1985).

D. M. Brink and G. R. Satchler, *Angular momentum, 3rd Ed.*, (Oxford University Press, Oxford, 1994).

A. R. Edmonds, *Angular momentum in quantum mechanics, 2nd Ed.*, (Princeton University Press, Princeton, 1960).

E. Feenberg and G. E. Pake, *Notes on the Quantum Theory of Angular Momentum*, (Dover, Mineola, 1999).

M. E. Rose, *Elementary theory of angular momentum*, (Wiley, New York, 1957).
Good pedagogical treatment of the theory of angular momentum.

* D. A. Varshalovich, A. N. Moskalev, and V. K. Khersonskii, *Quantum theory of angular momentum* (World Scientific, Singapore, 1989).
Comprehensive compilation of formulas related to the theory of angular momentum and irreducible tensors. Not a textbook.

R. N. Zare, *Angular Momentum: Understanding Spatial Aspects in Chemistry and Physics*, (Wiley, New York, 1988).

Astrophysical Applications

D. E. Osterbrock and G. J. Ferland, *Astrophysics of gaseous nebulae and active galactic nuclei, 2nd Ed.*, (University Science Books, Mill Valley, 2006).

A. R. P. Rau, *Astronomy-inspired atomic and molecular physics*, (Kluwer Academic Publishers, Dordrecht, 2002).

G. B. Rybicki and A. P. Lightman, *Radiative processes in astrophysics*, (John Wiley, 1979).

Other Applications

L. Allen and J. H. Eberly, *Optical resonance and two-level atoms*, (Dover, 1987).

R. Loudon, *The quantum theory of light, 3rd edition*, (Oxford University Press, Oxford, 2000).
Quantum optics plus a good treatment of the interaction of radiation with atoms.

H. J. Metcalf and P. van der Straten, *Laser Cooling and Trapping*, (Springer, New York, 1999).
Covers interaction of atoms with external fields, and applications to laser cooling.

C. J. Pethick and H. Smith, *Bose-Einstein condensation in dilute gases, 2nd Ed.*, (Cambridge University Press, Cambridge, 2008).
Includes a self-contained treatment of laser cooling and atomic collision theory.