12.6: Conclusion and References

To summarize the relative strengths of the effects discussed in this paper, table 4 gives some numbers for comparison of some energy splittings in the hydrogen atom. Note how much larger the principle energy splittings are than any of the other effects.

Table 12.6.1:Differences in energy of some particular pairs of states in the hy drogen atom The state of lower energy is listed rst

Effect	States	Energy difference (eV)
Principal splitting	$1s_(1//2),2s_(1//2)$	10.2
Fine structure	$2p_(1//2),2p_(3//2)$	$4.5xx10^(-5)$
Lamb shift	$2p_(1//2),2s_(1//2)$	$4.4xx10^(-6)$
	$3d_(3//2),3p_(3//2)$	$1.7xx10^(-8)$
Hyperfine structure	$1s_(1//2)(f=0),1s_(1//2)(f=1)$	$5.9xx10^(-6)$
Zeeman effect (B=10 gauss)	$2s_(1//2)(m_(j)=-1//2),2s_(1//2)(m_(j)=+1//2)$	$11.7xx10^(-7)$

The hydrogen atom is one of the most important dynamical systems in all of physics, for several reasons:

1. Hydrogen is the most abundant stuff in the known universe. About 92% by number of the nuclei in the universe are hydrogen, 75% by mass.
2. Even though it is a relatively simple system, the physics of the hydrogen atom contains many important quantum mechanical concepts that extend to more complex atoms and other systems.
3. Because of its relative simplicity, the hydrogen atom can be solved theoretically to very high precision. Experimental measurements involving hydrogen thus offer very sensitive tests of modern physical theories, like quantum electrodynamics.

References

1. Bjorken, J. D., and Drell, S. D. *Relativistic Quantum Mechanics.* McGraw-Hill, Inc., 1964.
2. Eisberg, R. M., and Resnick, R. *Quantum physics of atoms, molecules, solids, nuclei, and particles.* John Wiley & Sons, Inc., New York, second edition, 1985.
3. Feynman, R. P., Leighton, R. B., and Sands, M. *The Feynman Lectures on Physics.* Addison-Wesley, Reading, Massachusetts, 1965.
4. Griffiths, D. J. *Introduction to Elementary Particles.* Harper & Row Publishers, Inc., New York, 1987.
5. Shu, F. H. *The Physics of Astrophysics. Volume I: Radiation.* University Science Books, Mill Valley, California, 1991.

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