Problem Set 5

Physics 235 Fall Quarter 2004 H.J.Frisch HEP320 (702-7479)
Oct.25, 2004 Office Hours: Friday aft., or by appointment

Due Monday, Oct. 31. (hand in at class).

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Midterm: The midterm exam will be Friday, Nov. 5 (Election is Nov. 3rd- vote!).
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Reading This is a long reading assignment. Please allow enough time for it. Also, much of it is different in character from the reading in P234, and it may take you a while to get into an absorbent mode... The problems aren't trivial either.

The Effects of External Electrical and Magnetic Fields (Zeeman, Stark, and Paschen-Back Effects):

Eisberg and Resnick: Chapter 10, Section 10-6
Herzberg: Chapter II (pp.71-119)

Molecules- Vibrational and Rotational Spectra, Raman Effect:

Eisberg and Resnick: Chapter 12, Sections 12-4 to 12-8, inclusive.

Time Independent Perturbation Theory:

Shankar: Chapter 17 (pp.451-464).

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Problems:

1. (from Eisberg) Consider the 2p3s configuration of the ^6C atom, asuming LS coupling. Draw a schematic energy-level diagram for this configuration, scaling up the size of the splitting by a stated factor. Label each level in spectroscopic notation.

2. (from Eisberg) Draw a similar diagram for the same system showing the Zeeman splitting in a magnetic field of 1 Gauss (i.e. order-of-magnitude earth's field). How many different quantum states are there in this case?

3. (from Eisberg) Consider the $^2P_{\frac{1}{2},\frac{3}{2}}$ first excited state levels of Sodium and of its $^2S_{\frac{1}{2}}$ ground state. Draw the levels and indicate the transitions in a field of 50 Gauss. Then do the same in a field of 20,000 Gauss.

4. (from Eisberg) In the vibrational Raman spectrum of HF (Hydrogen-Fluoride) are adjacent Raman lines of wavelength 2760 Angstroms and 3340 Angstroms. What is the fundamental vibrational frequency of the molecule? What is the equivalent force constant?

5. Shankar Exercise 17.2.2

6. Shankar Exercise 17.2.3

7. Shankar Exercise 17.3.3