NAME_____

QUIZ 2

Physics 235 Fall Quarter 2004 H.J.Frisch HEP320 (702-7479)
Oct 20.,2004

(15 min: 2 questions- Fine Structure)

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The shift in energy due to fine structure in the hydrogen atom is described by the:

$$E_{n,j} = E_n \left(1 + \frac{\alpha^2 Z^2}{n} \cdot \left(\frac{1}{j+1/2} - \frac{3}{4n}\right)\right) \quad (1)$$

where n and j are the principal quantum number and the total angular momentum of the state, and E_n is the unperturbed energy of the state.

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Questions:

1. **Fine structure in hydrogen.**
   Calculate the splitting in the n =3 states of atomic hydrogen. Make a little table of n,l,m, and the ΔE due to fine structure.

2. The splitting between the $2S^{1/2}$ and the $2P^{1/2}$ states in hydrogen is named the Lamb shift, after Willis Lamb of Yale, who first measured it with R. C. Retherford in 1947. What is the predicted shift due to fine structure? (Show your calculation.)