

SECTION OVERVIEW

12.5: Smaller Effects

One correction to the Dirac theory involves the use of the reduced electron mass, which was previously discussed. Another involves considering that the proton has some finite size and is not exactly a point charge. Instead of having a $V = -Ze^2/r$ potential energy, one might imagine something like

$$V = \begin{cases} -\frac{Ze^2}{r} & r > r_0 \\ -V_0 & r \leq r_0, \end{cases} \quad (12.5.1)$$

where r_0 is some representative size of the proton $\sim 10^{-13}$ cm. Like the Darwin term, this will only affect s states, since only in these states can the electron be found at the origin. However, even for s states this correction turns out to be of the order $\Delta E \sim 10^{-10}$ eV, and hence it is not very important. Other effects will now be discussed which are more important, not only because the energy shifts are larger but because they split the energy levels of states that would otherwise be degenerate

From this point on, effects will only be discussed only in terms of the hydrogen atom, although they can be extended to other one-electron atoms.

Thumbnail: Pieter Zeeman

Contributors and Attributions

- Randal Telfer (JWST Astronomical Optics Scientist, Space Telescope Science Institute)

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