

1. Relativistic effects

From
$$\frac{\Delta E}{E} \approx \frac{v^2}{c^2}$$

and
$$\frac{v}{c} = \frac{\alpha}{n}$$

so that

$$\Delta E = \frac{\alpha^2}{n^2} E$$

The $n=2$ shell has

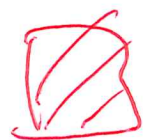
$$E = hcR_{\infty} = 3.4 \text{ eV}$$

hence

$$\Delta E = 4.5 \times 10^{-5} \text{ eV}$$

which requires resolution greater than

$$\frac{E}{\Delta E} = 75000 = \frac{4}{\alpha^2}$$



①

Gravitational force

$$F_G = \frac{G m_e M_p}{R^2} \quad \text{and} \quad F_e = \frac{e^2}{4\pi\epsilon_0 R^2}$$

so that

$$\frac{F_G}{F_e} = \frac{G m_e M_p}{e^2} 4\pi^2 \epsilon_0$$

$$= \frac{6.67 \times 10^{-11} \times 9.109 \times 10^{-31} \times 1.672 \times 10^{-27}}{2.56 \times 10^{-38} \times 9 \times 10^9}$$

$$= \frac{6.67 \times 9.109 \times 1.672 \times 10^{-40}}{2.56 \times 9}$$

$$= 4.4 \times 10^{-40}$$

and thus

$$F_e \gg F_G$$

and ignoring the
gravitational attraction
is justified



3. Zeeman effect

Magnitude of the Zeeman effect

$$\mu_B B = 14 \text{ GHz for } B = 1 \text{ T.}$$

Light of wavelength $\lambda = 600 \text{ nm}$ has $f = 5 \times 10^{14} \text{ Hz}$, hence

$$\frac{\Delta f}{f} = 3 \times 10^{-5}$$

Earth's field is about $5 \times 10^{-5} \text{ T}$.

