1. Reltivistic effects

From

$$\frac{\Delta E}{E} \simeq \frac{v^2}{c^2}$$

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

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

$\boxtimes$

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① Gravitational force

$$F_G = \frac{G m_e M_p}{R^2} \quad \text{and} \quad F_e = \frac{e^2}{4\pi\varepsilon_0 R^2}$$

so that

$$\frac{F_G}{F_e} = \frac{G m_e M_p}{e^2} 4\pi\varepsilon_0$$

$$= \frac{6.67\times10^{-11} \times 9.109\times10^{-11} \times 1.672\times10^{-27}}{2.56\times10^{-38} \times 9\times10^{9}}$$

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

$$= 4.4\times10^{-40}$$

and thus

$$F_e \gg F_G$$

and ignoring the gravitational attraction is justified

3. Zeeman effect

Magnitude of the Zeeman effect

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

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

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

Earths field is about 5×10^{-5} T.

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