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Derivation and Meaning of the Fine Structure Constant

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Abstract – No one knows exactly what is the fine structure constant, but its' meaning is very simple.

Hydrogen speed of the electron:

$$v = \frac{c}{137} \quad ; \quad \text{c – Light speed}$$

Perimeter of the orbit:

$$2\pi R = 137 x_e \quad ; \quad x_e \text{ -- Electron's Compton wavelength}$$

The meaning of the number 137 is very simple: for this value the total energy of the electron is minimum, being 137 the number of Compton wavelengths of the electron enclosed in the perimeter of the orbit.

Potential energy:

$$E_P = m_e g R \qquad \text{and} \qquad g = -\frac{q_e^{\,2}}{4\pi\varepsilon_0 R^2 m_e}$$

m_e -- Electron's mass; g – Acceleration; q_e -- Electron's charge; ε_0 -- Vacuum permittivity.

$$E_P = -\frac{q_e^{\,2}}{2\varepsilon_0 137 x_e}$$

Kinetic energy:

$$E_K = \frac{1}{2} m_e \frac{c^2}{137^2}$$

Total energy:

$$E = \frac{m_e c^2}{2N^2} - \frac{q_e^{\,2}}{2\varepsilon_0 x_e N}$$

For a minimum energy:

$$\frac{dE}{dN} = 0 \qquad \Leftrightarrow$$

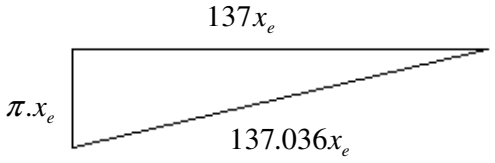
$$\Leftrightarrow \qquad \frac{dE}{dN} = \frac{{q_e}^2}{2\varepsilon_0 x_e N^2} - \frac{m_e c^2}{N^3} = 0 \qquad \Leftrightarrow$$

$$\Leftrightarrow \qquad N = \frac{2m_e c^2 \varepsilon_0 x_e}{{q_e}^2}$$

$$\Leftrightarrow \qquad N = 137.036$$

But if the value is not an integer the orbit is not stable.

We have proved in another paper that the electron in hydrogen has a double orbit. Each orbit has a exact perimeter of $137x_e$ and the distance between the two orbits is equal to $\pi.x_e$



Exact value of α^{-1}:

$$\alpha^{-1} = \sqrt{137^2 + \pi^2} = 137.03601572$$

Codata value:

$$\alpha^{-1} = 137.035999068$$

The inverse fine structure constant is the number of Compton wavelengths of the electron that makes the perimeter of half orbit in the hydrogen atom. This number is the one necessary to get a minimum energy of the electron.