

# Clarifying the origin of the fine-structure constant

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## 1. Overview

The fine-structure constant is generally considered to be a coupling constant that represents the strength of the electromagnetic interaction of elementary particles, but its origin is unknown. Using the electron and proton model of energy body theory, I clarified the origin of the fine-structure constant from the relationship between Coulomb's law and Planck's constant.

## 2. Derivation

### 2.1 Fine structure constant

The fine structure constant is:

$$\alpha = \frac{\mu_0 c e^2}{2h} = \frac{e^2}{4\pi\epsilon_0 \hbar c}$$

The fine structure constant was introduced by Sommerfeld in 1916 to explain the fine structure that appears in the spectral lines of hydrogen-like atoms. It is now considered to be a coupling constant that describes the strength of electromagnetic interactions between elementary particles in a more general sense, independent of atomic structure. However, it is not known why this value appears.

Related equations

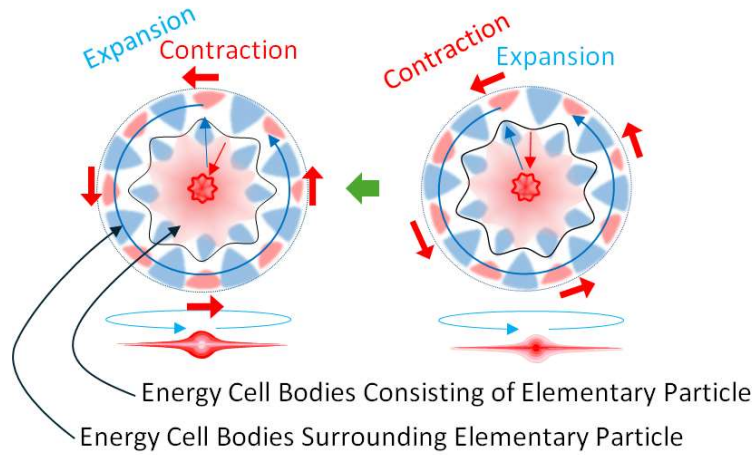
$$c^2 = \frac{1}{\mu_0 \epsilon_0}, \quad k_0 = c^2 \cdot 10^{-7} = \frac{\mu_0 c^2}{4\pi}, \quad \mu_0 = 4\pi \cdot 10^{-7}, \quad \hbar = \frac{h}{2\pi}, \quad h\nu = h \frac{c}{\lambda}$$

### 2.2 Particle model of energy body theory

When the energy cell bodies receive pressure from all directions of the celestial sphere, they contract to the limit. However, if the pressure is greater than this, the energy has nowhere to go and starts to rotate. On the other hand, the energy cell bodies that have contracted to the limit expand because the pressure is deflected. In this way, the pressure that was moving toward the center is instantly converted into rotational energy, so the expansion and contraction rotate as vibrations. It is important to note here that the entire elementary particle that is formed does not rotate around like a top. This rotation of energy appears as the crests and troughs of a wave like wrinkles extending radially from the center, and the phase shifts in

the direction of rotation. This rotation of the wave is a de Broglie wave. This is the cause of the spin of elementary particles. Due to the balance with this gravitational field and their own spin, the energy cell bodies can continue to exist as elementary particles such as electrons and protons.

**Elementary particle model of energy body theory**



The energy cell bodies in space, which are much smaller than elementary particles, contract and expand radially. The expansion and contraction spin out of phase radially.

Fig.1

Elementary particles have a disk-like shape with the foot that spreads out into space. The particle in the center represents a particle, and the foot represents a field.

**Particle model of energy body theory**

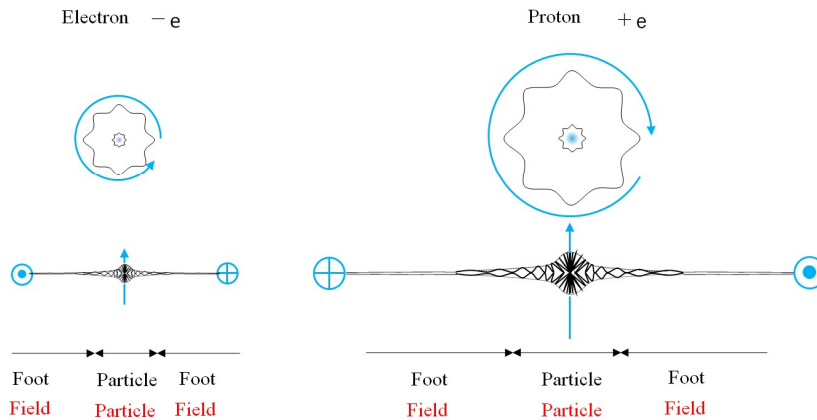


Fig.2

Electromagnetic interaction depends on the direction of the waves at the interaction; when the waves are in the same direction, an attractive force occurs, and when the waves are in opposite directions, a repulsive force occurs.

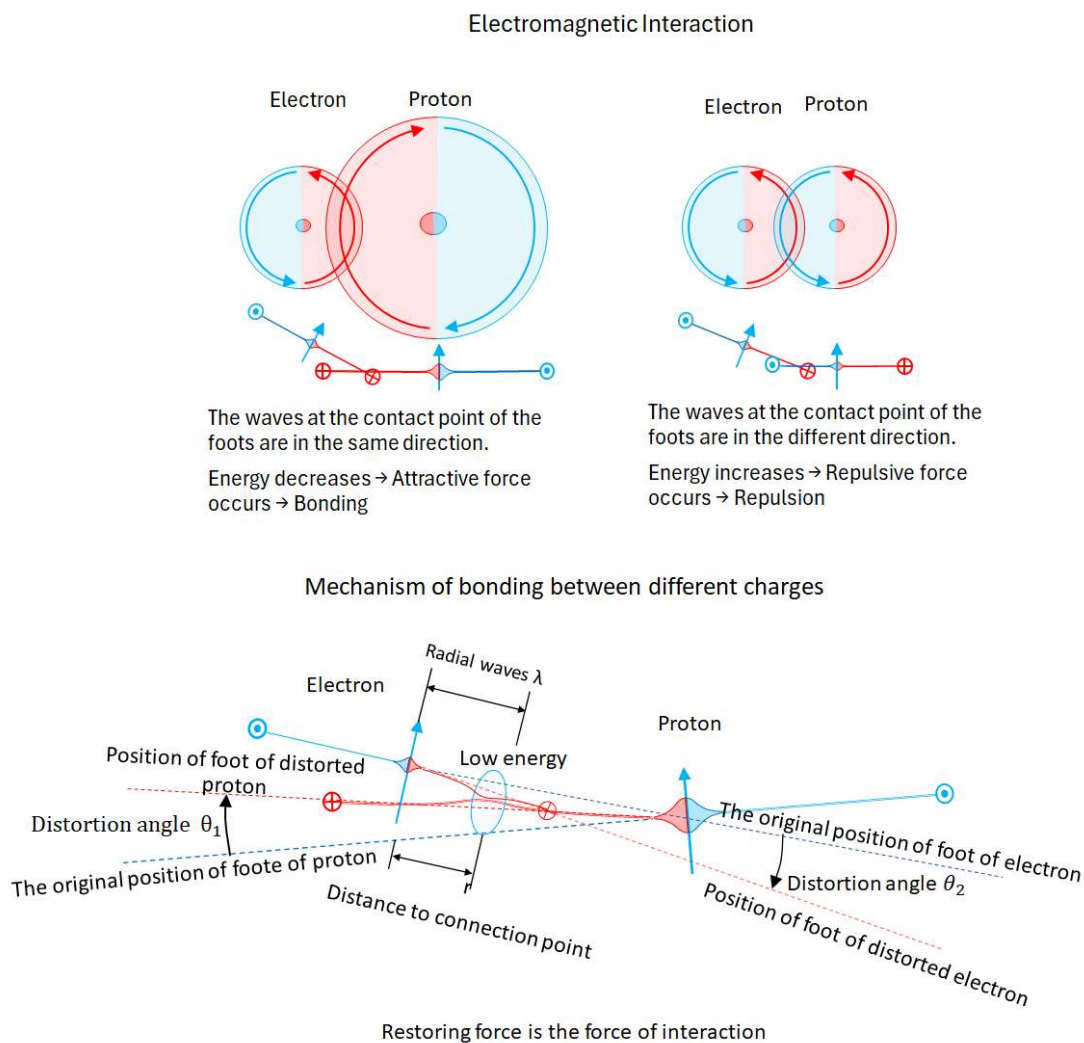


Fig.3

### 2.3. Derivation

The fine structure constant is derived using the following method based on Figures 4 and 5. Note that the electron on the proton orbit is bound to the proton in the posture shown in Figure 4. When an excited state electron transitions to the ground state orbit, the base of the electron becomes distorted (negative energy), generating a wave of kinetic energy in the space in front of the electron. The electron is dragged along by this wave and moves. The kinetic energy that leaves the electron becomes a photon.

# Electron transition and photon emission

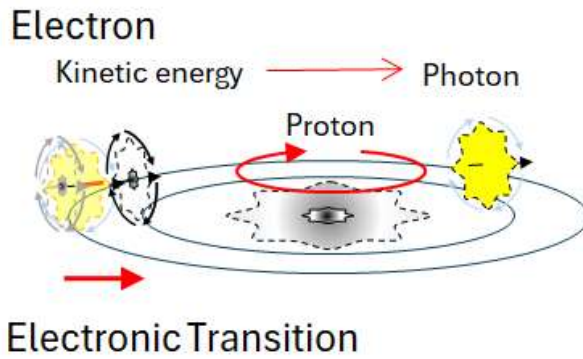
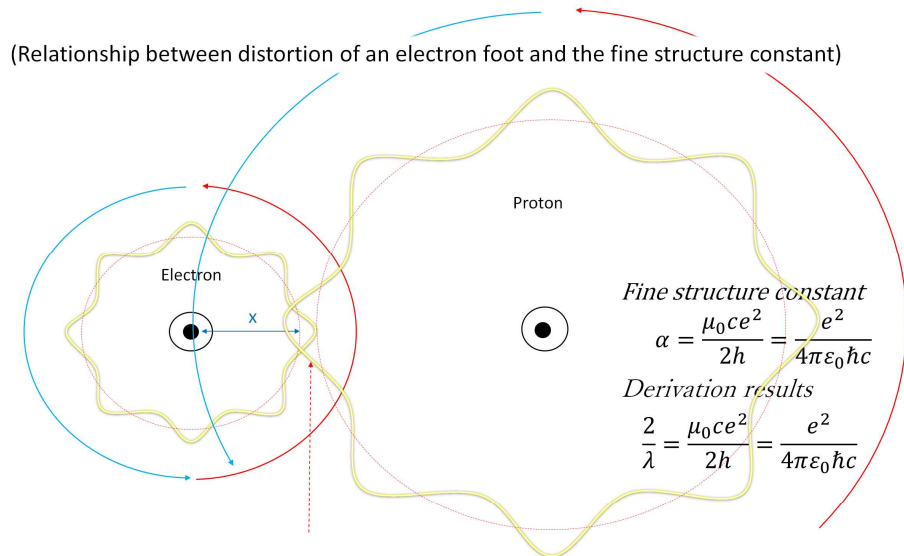


Fig.4



Relationship between distortion of an electron foot and the fine structure constant

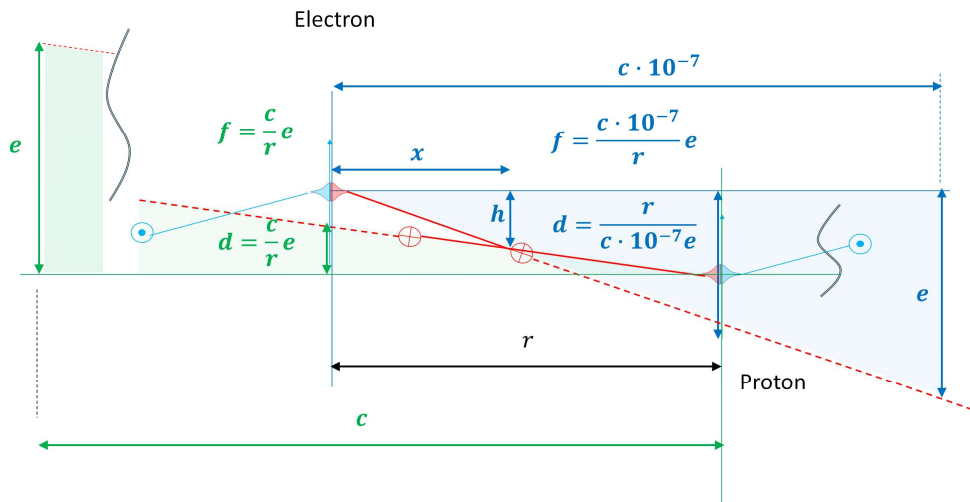


Fig.5

Planck's constant  $h$ , Coulomb's constant, and electromagnetic interaction are the effects by the distortion generated in the electron's foot and the restoration from that. Also, the speed of light is the ratio of the delay in time it takes for a photon's foot to reach an observer to the distance to the photon. This is because the arrival of the foot of light is delayed due to the photon's foot distortion observing the side perpendicular to the direction of travel of the photon. It is shown in Figure 6. The speed of the photon inherits the speed of the electron just before it is separated.

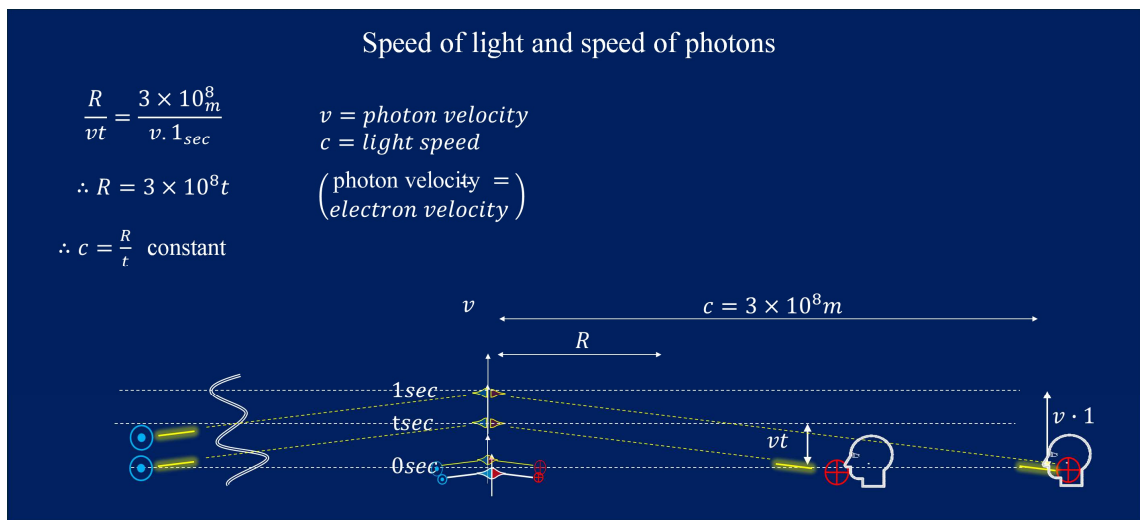


Fig.6

Let the position of the foot of an electron bound to a proton be  $x$ , its strength be  $h$ , the distance between the electron and the proton be  $r$ .

The origin (derivation) of the fine structure constant is as follows:

The position of the foot of the electron bound to the proton is  $x$ , and its strength is  $h$ . Also, Coulomb's law is as follows (1).

$$f = k_0 \frac{e^2}{r^2} \quad (1)$$

Here, since  $k_0 = 10^{-7} c^2$ , (1) becomes (2).

$$f = 10^{-7} c^2 \cdot \frac{e^2}{r^2} \quad (2)$$

Transforming (2) gives us (3).

$$\pi r^2 f = \pi \times 10^{-7} ce \times ce \quad (3)$$

Therefore, the restoration energy  $E_k$  of the foots of the electron and proton due to their

interaction is given by (4) below.

$$E_k = \pi \times 10^{-7} ce \times ce \quad (4)$$

The energy  $E_p$  at the bonding point of an electron and a proton is given by (5) using the equation for Planck's constant.

$$E_p = hv = h \frac{c}{\lambda} \quad (5)$$

Since  $E_k$  and  $E_p$  are the same, (4) and (5) become the following (6).

$$\pi \times 10^{-7} ce \times ce = h \frac{c}{\lambda} \quad (6)$$

Rearranging (6) gives (7).

$$\frac{\pi \times 10^{-7} ce \times ce}{hc} = \frac{1}{\lambda} \quad (7)$$

Here,  $\mu_0 = 4\pi 10^{-7}$  so multiplying both sides of (7) by 2 gives us (8).

$$\frac{2\pi\mu_0 \times ce \times ce}{4\pi hc} = \frac{2}{\lambda} \quad (8)$$

Setting  $\alpha = 2/\lambda$  gives the fine structure constant (9).

$$\frac{\mu_0 ce^2}{2h} = \frac{e^2}{4\pi\epsilon_0 \hbar c} = \alpha \quad (9)$$

### 3. Conclusion

I have found that the fine structure constant originates from the distortion of the foot of the electron model of the energy body theory. It was then possible to show that the fine structure constant can be derived from Coulomb's law and Planck's constant.

### 4. Reference

Wikipedia; fine structure constant