New Physics II: Spin Picture, Particle Structure, and Fundamental Interactions

China Kang (kangstudy@outlook.com)
N/A

Article

Keywords: quantum phenomena, universal classical theory, particle structure

Posted Date: November 30th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-1116117/v1

New Physics II: Spin Picture, Particle Structure, and Fundamental Interactions

China Kang

Email: kangstudy@outlook.com

Abstract: Experimental data sometimes fails to render the expected truth, such as high-speed bullets smashing into pieces on a water surface cannot verify the water's hardness. By re-examining the essence underneath quantum phenomena and analyzing their relevance to universal classical theory, this study has thoroughly revealed the classical counterpart of spin. From now on, almost all quantum concepts (e.g., wave particle duality, quantum entanglement, and magnetic moment anomaly) can be understood classically, just as prominent physicists such as Planck, Einstein, and Schrödinger longed for back then.

I. Introduction

Richard Feynman famously quipped, "I think I can safely say that nobody understands quantum mechanics." Until now, quantum concepts such as Schrödinger's cat and quantum entanglement still baffle the public. Moreover, quantum mechanics continues using the nuclear magneton $\mu_{\mathrm{N}} = \frac{e\hbar}{2m_{\mathrm{p}}}$ predicted by imitating the Bohr magneton $\mu_{\mathrm{B}} = \frac{e(\alpha c/n)}{2\pi(na_0)}[\pi(na_0)^2] = \frac{e[a_0 m_{\mathrm{e}}(\alpha c)]}{2m_{\mathrm{e}}} = \frac{e\hbar}{2m_{\mathrm{e}}}$ of a circular-motion electron. Seemingly, we have yet to grasp quantum mechanics from the ground up. Beyond limited and one-sided experimental data, from the universality of nature rules, it can be deduced that the key to clarifying quantum mechanics and unifying physical theories should be to figure out the classical counterpart of spin.

Note that limited experiments can sometimes generalize locally correct patterns but fail to provide the truth. For example, the sun rising in the east and setting in the west every day does not denote that the sun revolves around the earth, and the high-speed bullet smashing into pieces on a water surface cannot attest that the water is hard. Considering that nature enjoys simplicity shown in Newton's second law of motion and the inverse-square law, it must be critical to start with the extensively applicable basic theory when illuminating experimental phenomena. Otherwise, the geocentric model would persistently perfect its accuracy and scope in depicting observed phenomena by introducing more than 13 free parameters.

In this paper, the classical counterpart of spin is ascertained based on the correspondence principle and relevant experimental data, which not only enables almost all quantum puzzles to be clarified but opens the door to unifying quantum mechanics and classical mechanics.

II. The Classical Counterpart of Spin

It is known that Bohr magneton $\mu_{\mathrm{B}} = \frac{e\hbar}{2m_{\mathrm{e}}} = \frac{e(\alpha c/n)}{2\pi(na_0)}[\pi(na_0)^2] = \frac{1}{2}\left|n\boldsymbol{a_0} \times e\frac{\alpha c}{n}\right|$ is akin to the coil-current magnetic moment and charge-revolving angular momentum (disregarding electron clouds for now). Moreover, the electron-mass spin satisfying $na_0 m_{\mathrm{e}}\frac{\alpha c}{n} = \hbar \Rightarrow |\boldsymbol{r_\Omega} \times m_{\mathrm{e}}\boldsymbol{v}| = \hbar$ at different energy levels of a hydrogen atom equals the angular momentum of electron-mass revolving. For photons, the correlation of their wavelength and polarization, we can express the Planck constant as $h = 2\pi\hbar = E_\gamma T_\gamma = p_\gamma c T_\gamma = \lambda p_\gamma = 2\pi r_\Omega m_\gamma c$ (;$r_\Omega = \frac{\lambda}{2\pi}$; $m_\gamma = \frac{E_\gamma}{c^2}$ is not a rest mass but an energy factor).

Now we can infer that the classical counterpart of spin is none other than circular motion (disregarding composite particles temporarily). Naturally, circular polarization is a spiral motion with spin angular momentum parallel to translational momentum, and linear polarization is a cycloidal motion with spin angular momentum perpendicular to translational momentum. Furthermore, the photon's energy $E_\gamma = h\nu_\gamma = p_\gamma c = m_\gamma c^2 = 2E_k^\gamma$ is purely kinetic, contributed jointly by its light-speed spin and light-speed translation. In fact, 300 years ago, Newton conjectured "it consists in a circulating or a vibrating motion of the Ray, or of the Medium, or something else" when he discussed the reflection and refraction of photons[1].

Since the spin of electrons satisfies $r_\Omega m_\mathrm{e} v = \hbar$, its spin quantum number $\frac{1}{2}$ should result from the spin-vortex-surface polarization tension or spin magnetic moment nullifying half of its mass-spin angular momentum: $|\boldsymbol{S}_\mathbf{e}| = \frac{1}{2} r_\Omega m_\mathrm{e} v = \frac{1}{2}\hbar$. For an electron moving at a near-light speed in a vacuum, its de Broglie wavelength ($\lambda = 2\pi r_\Omega$) will be shorter, and thus the mass m_e in the formula $r_\Omega m_\mathrm{e} v = \hbar$ needs to be replaced by a mass-like variable derived from its moving system energy. (Which can be verified by double-slit interference of near-light-speed electrons.)

When an electron is in an external magnetic field, its spin-angular-momentum orientation tends toward the parallel or antiparallel direction relative to the magnetic field due to the magnetic torque. Indeed, the spin-orientation change of an electron is caused by the classical collision between the electron and vacuum particles (their spins are not in the same plane; see §3.6 for vacuum particles). Assuming that the angle between an electron's initial spin and a new applied magnetic field is a random θ $(0 \leq \theta \leq \pi)$, then the spin-projection changed amount $S_\mathrm{e}(1 \pm \cos\theta)$ of the electron determines its spin-orientation statistical probability

$$P_\updownarrow = \frac{1 \pm \cos\theta}{(1+\cos\theta)+(1-\cos\theta)} = \begin{cases} P_\uparrow\colon \cos^2(\theta/2) \\ P_\downarrow\colon \sin^2(\theta/2) \end{cases} \ (0 \leq \theta \leq \pi). \tag{1}$$

This statistical probability mirrors, in essence, nothing more than the classical distribution of the classical measurements resulting from classical collisions.

Constrained by energy conservation and angular momentum conservation, a single particle cannot be simultaneously in a space-position-pervading or spin-orientation-superposition state. At every point of the one-way timeline, any particle has a definite, sole, classical space position and spin orientation in an observer's reference frame. Naturally, the quantum tunneling of electrons is closely related to the transition, transmission, diffraction, Newtonian pendulum model, and the identity of electrons, which can also be considered a phenomenon in line with classical theory.

As for quantum entanglement, its essence is nothing more than the correlation of independent measurement results between particles whose initial spin angular momenta have strong symmetries (e.g., parallel, and antiparallel). For example, the spins of spin-symmetric electrons tend to remain spin-symmetric after crossing the same magnetic field, which is substantially as classical as the left-right symmetry of a pair of gloves.

Essentially, the Planck constant characterizes the vortex of elementary particles spinning in space (vacuum), written in the integral form as

$$h = \int_0^{\lambda/v} mv^2\,\mathrm{d}t = \oint_0^{2\pi r_\Omega} mv\,\mathrm{d}l = \iint_0^{\pi r_\Omega^2} m\Omega\,\mathrm{d}A \quad \left(\Omega = |\nabla \times \boldsymbol{v}| = \frac{2v}{r_\Omega}\right). \tag{2}$$

This equation manifests the equivalence between spin circulation and spin-vorticity flux, reflecting the continuum properties of space and the one-way nature of time. The constant $h = m\Omega A_T > 0$ is equivalent to the energy-vorticity flux ($mc^2\Omega A_T$), which is closely related to the single directivity of the same fundamental interaction: For example, apples grow ripe from unripe and fall onto the ground after ripening, but this sequence must never happen in reverse.

Indeed, the vacuum regarded as a non-dispersive medium (the ether) is a critical mechanical model in Fresnel optics and Maxwell electromagnetism. Moreover, Einstein never outright denied that the ether exists, and experiments have proven that the vacuum is non-empty. Accordingly, the superfluid properties (see §3.6) of the vacuum and the circular spin of elementary particles (even if bound inside composite particles) inevitably lead to particles exhibiting wave-particle duality. By now, we can already elucidate both single-particle two-slit interference and delayed-choice quantum eraser experiments through the same unified wave theory.

Considering the spin-vortex-core tension of electrons and the steric structure of atoms, we can infer that hydrogen atoms' discrete energy-level orbitals (ring bands) have a stratified equipotential spherical-shell structure. Thus, the magnetic quantum number m should follow

$$|m| = (l+1)(1-\cos\theta) \le l \quad \left(m \in \mathbb{Z};\ l \in \mathbb{Z}_{\ge 0};\ -\frac{\pi}{2} < \theta < \frac{\pi}{2}\right). \tag{3}$$

Note that the electron's revolution on an s-shell (orbital angular momentum is zero) is just the spin.

For helium atoms and helium-like ions, the ground-state Bohr energy E_Z approximates the potential energy of the two electrons revolving around a nucleus at the same spin-orbit:

$$E_Z = -r_1\left[\frac{Ze^2}{4\pi\varepsilon_0 r_1^2} - \frac{e^2}{4\pi\varepsilon_0(2r_1)^2}\right] = -m_e v_1^2 \approx -\left(Z - \frac{1}{4}\right)^2 m_e(\alpha c)^2. \tag{4}$$

Substituting the relevant experimental data (from NIST), it gives $|(E_2 - E_2^{EXP})/E_2^{EXP}| \approx 5.4\%$, $|(E_{20} - E_{20}^{EXP})/E_{20}^{EXP}| \approx 0.14\%$, and $|(E_{30} - E_{30}^{EXP})/E_{30}^{EXP}| \approx 0.70\%$ ... Therefore, the motion of the electron outside nuclei can entirely be investigated from a particle viewpoint.

Notably, the vacuum electromagnetic medium is an essential element participated in the expression of many properties of macroscopic matter such as shapes, colors, temperature, and binding energy. For a free electron ($rm_e v = \hbar$), $\frac{h}{e} = \oint_0^{2\pi r_\Omega} \frac{m_e}{e} v\,\mathrm{d}l = \iint_0^{\pi r_\Omega^2} \frac{m_e}{e} \Omega\,\mathrm{d}A$ depicts both spin-speed circulation and spin-vorticity flux. Correspondingly, Cooper pair magnetic flux can be expressed as $\Phi_0 = 2\iint_0^{\pi\left(\frac{r}{4}\right)^2} \left|\nabla \times \frac{m_e}{e}\boldsymbol{v}\right| \mathrm{d}A = 2\oint_0^{2\pi\frac{r}{4}} \frac{m_e}{e} v\,\mathrm{d}l = \frac{2\pi r m_e v}{2e} = \frac{h}{2e}$, implying that the Cooper pair is probably the electron pair composed of two counter-spinning electrons paired into two-body orbital motion with $\frac{r}{4}$ as the radius.

As mentioned above, numerous quantum puzzles are viable to understand intuitively after identifying the classical counterpart of elementary particle spins.

III. Spin-related Concepts

Spin has no genesis, which is the basic form of energy timelessly existing and the intrinsic motion of energy carriers (elementary particles). Now, from spin corresponding to circular motion, let's re-examine some spin-related experimental phenomena, such as spin magnetic moment, magnetic moment anomaly, parity breaking, vacuum quantization, and fundamental interactions.

§ 3.1 Spin magnetic moments

As an example of the spin magnetic moment, the Bohr magneton can be expressed as

$$\mu_{\mathrm{B}} = \frac{1}{2}|\boldsymbol{r}_{\Omega} \times e\boldsymbol{v}| = \frac{1}{4\pi}\oint_0^{2\pi r_\Omega} e\boldsymbol{v}\cdot \mathrm{d}\boldsymbol{l} = \frac{e r_\Omega^2}{4}(\boldsymbol{\nabla}\times\boldsymbol{v}) = \frac{1}{4\pi}\iint_0^{\pi r_\Omega^2} e\boldsymbol{\Omega}\cdot \mathrm{d}\boldsymbol{A} \quad (r_\Omega m_{\mathrm{e}} v = \hbar), \tag{5}$$

indicating that the spin magnetic moment is the charge-spin angular momentum and is equivalent to the charge-speed circulation and the charge-vorticity flux. Therefore, the spin magnetic moment totally can be articulated by the regular motion of charges, without bothering too much about the mass-spin angular momentum (especially for hadrons).

However, for a near-light-speed electron in a vacuum, if its spin radius reaches $r_\Omega \ll \frac{\hbar}{m_{\mathrm{e}}c}$, and then there is $\frac{1}{2}r_\Omega ec \ll \mu_{\mathrm{B}}$? In this case, the electron spin magnetic moment remaining constant should permit its charge spin not to coincide with its near-light-speed system-energy spin. More likely, the near-light-speed electron can induce spherical-shell-like negative and positive polarization charges that rotate contrarily to maintain the spin magnetic moment. Since near-light-speed electron collisions can also produce the mesons and hadrons generated in high-energy proton collisions[2] (which certainly will eventually be fully verified), measuring the magnetostatic fields around polar particles has the equal experimental value as large collider experiments.

Experiments have proved that electricity and magnetism are two kinds of kinematic properties of the identical thing – the motion state of electric charges relative to an observer's static vacuum medium determines its observable electromagnetic manifestations. Considering $q_m = \mu_0 qv$ as a magnetic charge, then the line current induces a magnetic field

$$\mathrm{d}\boldsymbol{H} = \frac{\mathrm{d}q_m}{4\pi\mu_0 r^2}\vec{\boldsymbol{e}} = \frac{\mu_0 v\,\mathrm{d}q}{4\pi\mu_0 r^2}\vec{\boldsymbol{e}} = \frac{vI\,\mathrm{d}t}{4\pi r^2}\vec{\boldsymbol{e}} = \frac{I\,\mathrm{d}\boldsymbol{l}\times\boldsymbol{r}}{4\pi r^3} \quad (\boldsymbol{\nabla}\cdot\boldsymbol{H} = 0), \tag{6}$$

which is precisely Biot-Savard's law. Because the magnetic field arises from the directional vortices of the vacuum electromagnetic medium induced by the moving charge, the magnetic pole is nothing but the characteristic direction of the charge-vorticity flux (magnetic moment or charge angle momentum). Thus, there can be no magnetic monopole in the universe.

In fact, the so-called magnetic moment anomaly is the most natural phenomenon, but the theory is bound to have limitations and is unable to predict all experimental results precisely. Conceivably, the cyclical spin of charges is accompanied by other regular motions, thus causing the magnetic moment anomaly to approximate a constant. Moreover, the scattering cross-section and charge radius of particles carrying nonzero magnetic moments imply that the elementary charge should have a well-regulated structure, which is also the experimental basis for re-examining the structure and constituent of particles.

§ 3.2 Electron structure

When one electron and one positron annihilate, their energy is released in the form of photons. Where do their electric charges go, and how are the emitted photons created?

Considering the annihilation of particle and antiparticle pairs, the decay of neutral mesons, the energy released from mass loss in nuclear reactions, and the mass-energy equation $E = m_0c^2$, it can be inferred that the electric charge itself has no energy, and that bound-state photons furnish the energy of non-photon particles. Essentially, a pair of negative and positive charges released from the annihilation of an electron and a positron certainly will pair up (transforming into negative-positive virtual electron pairs) and hide in the vacuum. Moreover, electrons and positrons can be considered ions of the vacuum electromagnetic medium: For example, collisions of near-light-speed electrons' magnetic fields (induced by the vortex of vacuum electromagnetic media) can pairwise produce electron-positron pairs from the vacuum.

Up to now, the precise charge radius of electrons has not been pinpointed. Is this because the electron has no charge radius or possesses an elastic charge-outer-shell? Experimentally, an electron possesses a low-energy-state scattering cross-section, and its electrostatic self-energy converges to a constant, meaning that the electron must have an elastic spherical charge-shell that can be distorted and pierced but not fragmented. Naturally, the charge of an electron is furnished by its shell carrying an elementary charge; its mass $m_{\mathrm{e}} = \frac{1}{c^2}\left(\frac{M_{\mathrm{P}}}{m_{\mathrm{p}}}\right)^2 \frac{GM_{\mathrm{P}}^2}{r_{\mathrm{U}}} = \frac{1}{c^2}\frac{GM_{\mathrm{P}}^2}{\lambda_{\mathrm{C}}} = \frac{1}{c^2}\frac{e^2}{4\pi\varepsilon_0 r_{\mathrm{e}}}$ is contributed by a bound-state photon inside the shell as an energy standing wave in the gravitational field. In addition, the root reason why the electron does not decay should be that its bound-state photon always reflects back and forth inside the charge-shell and cannot spontaneously scatter out.

Inside an electron, the bound-state photon spins at the speed of light (orbiting the spin-vortex-core) and reflects back and forth at the speed of light, thereby behaving as cycloidal oscillation. Meanwhile, the charge-shell will delay by one period and move in the selfsame cycloidal motion. Conceivably, one arch span $2\pi r_{\mathrm{c}}$ of the cycloidal motion is just the charge-radius r_{e} at which the electromagnetic energy of the electron converges to $m_{\mathrm{e}}c^2 = \frac{1}{2}\frac{e^2}{4\pi\varepsilon_0 r_{\mathrm{e}}} + \frac{1}{2}\frac{(\mu_0 ec)^2}{4\pi\mu_0 r_{\mathrm{e}}} = \frac{e^2}{4\pi\varepsilon_0 r_{\mathrm{e}}}$. (Such a direct relation is only applicable to charged leptons; the elementary charge is a basic, extraordinary, indivisible, and indestructible spherical shell.) Thus, the contribution of the electron self-energy oscillation to its spin magnetic moment is

$$\mu_{\mathrm{e}}' = -\frac{1}{2}|\boldsymbol{r}_{\mathbf{c}} \times e\boldsymbol{c}| = -\frac{1}{2}\frac{r_{\mathrm{e}}ec}{2\pi} = -\frac{1}{2\pi}\frac{er_{\mathrm{e}}m_{\mathrm{e}}c}{2m_{\mathrm{e}}} = -\frac{\alpha}{2\pi}\mu_{\mathrm{B}}, \tag{7}$$

which is precisely the self-energy correction term for electron spin magnetic moment in quantum electrodynamics. Note that $|\boldsymbol{r}_{\mathbf{c}} \times m_{\mathrm{e}}\boldsymbol{c}| = \frac{\alpha}{2\pi}\hbar$ shows that the bound-state spin of a particle bound in the charge-shell does not necessarily obey $|\boldsymbol{r}_{\boldsymbol{\Omega}} \times m\boldsymbol{v}| = \hbar$ (which usually follows $r_{\Omega}mv \ll \hbar$).

The measured value of the electron magnetic moment anomaly is less than $\frac{\alpha}{2\pi}$. Theoretically, the charge-shell of electrons should keep rotating. Therefore, it must be mainly the charge-shell rotating in the opposite direction of the electron spin, which causes the electron magnetic moment anomaly to be less than $\frac{\alpha}{2\pi}$. From the classical perspective of electrodynamics, the electron magnetic moment anomaly can be expressed as $a_{\mathrm{e}} = \frac{1}{a_0\alpha c}\left(|\boldsymbol{r}_{\mathbf{c}} \times \boldsymbol{c}| - \frac{2}{3}|\boldsymbol{r}_{\mathbf{e}} \times \boldsymbol{v}|\right)$ – the relevant correction term also needs to consider only the regular motion of the charge (including polarized charges) in the vacuum electromagnetic medium.

§ 3.3 Muon structure and time dilation

Muons possess electromagnetic properties remarkably akin to electrons. However, within an average of 2 μs after creation, muons will spontaneously decay into electrons and release energy in the form of neutrinos. Accordingly, the muon can be considered a composite electron with a higher-energy magnitude. Another difference from the electron is that the muon magnetic moment anomaly exceeds $\frac{\alpha}{2\pi}$, and thus its charge shell should rotate in the same direction as its spin.

The average lifetime of muons influenced by speed is considered to confirm time dilation, but why is the timing period of pendulum clocks affected by gravitational acceleration not regarded as evidence of time dilation? Even in the Hafele-Keating experiment, why is time dilation independent of the relative velocity between the aircraft and the ground but dependent on the centripetal acceleration of the aircraft with respect to the earth's center (there is no time dilation between different reference frames having the same acceleration relative to the earth's center)?

Furthermore, for the atomic clock on a GPS satellite, why can its timing period be expressed as the centripetal acceleration relation $T_{GPS} \approx \frac{cT_{\oplus}}{\sqrt{c^2-(2R_G g_G-2R_{\oplus} g_0)-R_G a_G}} = \frac{T_{\oplus}}{\sqrt{1-(3R_G g_G-2R_{\oplus} g_0)/c^2}}$?

In fact, photons that constantly fluctuate (spin) in space and continuously frequency-shift in gravitational fields are also experiencing the uniform elapse of the background time (absolute, true, and mathematical Newtonian time). Consequently, the so-called time dilation is nothing more than the period variation of the characteristic motion (e.g., particle decay, energy-level transition) of objects in different accelerated states (including spin centripetal acceleration). As shown in the Hafele-Keating experiment and the timing period of the atomic clock on GPS satellites, it is not the relative speed but the centripetal acceleration that determines time dilation (period variation).

For high-speed muons (ignoring gravity), their average life can be expressed as

$$T_v \approx \frac{cT_0}{\sqrt{c^2-(r_v a_v - r_0 a_0)}} = \frac{T_0}{\sqrt{1-(v^2-v_0^2)/c^2}} \quad (v_0 > 0), \tag{8}$$

where $\sqrt{c^2-(r_v a_v - r_0 a_0)} = \{[m_\mu c^2 - (m_\mu r_v a_v - m_\mu r_0 a_0)]/m_\mu\}^{1/2}$ indicates the relative rotational speed between the muon's bound-state energy particle (revolving at the speed of light) and its rotating spin-vorticity field.

For a given muon, its internal energy particles will scatter from the specific exit of its interior equipotential field while moving a corresponding fixed distance relative to its rotating charge-shell, thus exhibiting a spontaneous decay whose period is associated with spin speed. Moreover, the spontaneous transition (from higher to lower energy levels) of electrons outside the nucleus is akin to muon decay, reflecting the kinematic model for the so-called time dilation of polar subatomic particles with discrete energy levels.

It is worth mentioning that, just as an observer at rest relative to a point charge can only observe its electrostatic field (vacuum is approximately at rest with the observer), the speed of light in a vacuum is the speed of light in the observer's static vacuum. Moreover, Fizeau's empirical formula $c_n = \frac{c-v/n}{n} + v = \frac{c}{n} + \left(1-\frac{1}{n^2}\right)v$ can also explain the constancy of the speed of light in the vacuum ($n = 1$) from the perspective of Galilean transformation. (The vacuum dragged by observers does not interfere with the measurable speed of light in any reference frame.)

In addition, when a particle with a non-zero magnetic moment moves at a speed of v relative to the celestial body's gravitational field in which the observer is located, its measurable system energy (of an electromagnetic spin-vorticity field) should be

$$E_v \approx \frac{m_0 c^2}{\sqrt{1-(v^2-v_0^2)/c^2}} \quad (v \le c;\ \ v_0 > 0), \tag{9}$$

which does not apply to zero-magnetic-moments neutral particles such as photons and neutrinos.

At this point, it can be judged that special relativity distorted space and time – its partial correctness is nothing more than a mathematical coincidence, just like the one-sided validity of the geocentric model. Indeed, discussions such as the twin paradox, ladder paradox, and time travel are more like logical games or artistic imagination than physics.

§ 3.4 Neutrino chirality and beta decay

As shown in $\mu^- \to e^- + \bar{\nu}_e + \nu_\mu$ and $\mu^+ \to e^+ + \nu_e + \bar{\nu}_\mu$, both muon and anti-muon decay release one charged particle and two neutral neutrinos with zero magnetic moments. Why does the released charged particle (e^- or e^+) tend toward emitting in the direction of the muon or anti-muon magnetic moment? Is this really caused by the parity breaking of neutrinos? (Don't forget Lenz's law in electromagnetic interactions and the magnetic moment equivalent to the charge vortex flux in space media.) Furthermore, what is the essential difference between different neutrinos (if parity can be ignored as disregarded in Dirac's "The Principles of Quantum Mechanics")?

Neutron decay likewise releases the $\bar{\nu}_e$:

$$\mathrm{n}_{1/2} \to \mathrm{p}_{1/2} + \mathrm{e}^- + \bar{\nu}_e, \text{ or } \mathrm{n}_{1/2} \to \mathrm{p}_{-1/2} + \mathrm{e}^- + \bar{\nu}_e, \tag{10}$$

where the subscript of the nucleon indicates the spin quantum number and spin direction. Experiments demonstrate that the energy spectrum of β^- (e^-) rays is continuous, and the corresponding energy of $\bar{\nu}_e$ is a variable within the interval $(0,\ m_\mathrm{n}c^2 - m_\mathrm{e}c^2)$. Accordingly, neutrinos are photon-like neutral energy carriers, and carrying different magnitudes of energy is one of the essential distinctions between diverse neutrinos. Undoubtedly, neutrinos in a vacuum certainly will travel at the speed of light (see below for neutrino oscillation). Even if the average speed of neutrinos across a large-scale medium (including various lighttight liquids and solids) is marginally lower than the speed of light in a vacuum, is it not supremely natural?

Neutrinos are viewed as chiral particles that violate the law of conservation of parity. For example, the two beta decay types are as follows (disregarding parity tentatively):

$$\left.\begin{aligned} &{}^{60}_{27}\mathrm{Co}_{I=5} \to {}^{60}_{28}\mathrm{Ni}_{I=4} + \mathrm{e}^- + \bar{\nu}_e \quad \left(\mathrm{n}_{1/2} \to \mathrm{p}_{-1/2} + \mathrm{e}^-_{1/2} + \bar{\nu}_{1/2}\right), \\ &{}^{58}_{27}\mathrm{Co}_{I=2} \to {}^{58}_{26}\mathrm{Fe}_{I=2} + \mathrm{e}^+ + \nu_e \quad \left(\left[\mathrm{p}_{1/2} + \gamma_{-1}\right] + \gamma_1 \to \mathrm{n}_{-1/2} + \mathrm{e}^+_{1/2} + \nu_{1/2}\right), \end{aligned}\right\} \tag{11}$$

where the nuclear spin $I \neq 0$ of the even-even nuclei ${}^{60}_{28}\mathrm{Ni}$ and ${}^{58}_{26}\mathrm{Fe}$ means excited states. Since the number of nucleons remains unchanged and the nuclear spin loses $\hbar$ when ${}^{60}_{27}\mathrm{Co}_{I=5}$ decays into ${}^{60}_{28}\mathrm{Ni}_{I=4}$ ($\Delta I = -1$), the decay path must be $\mathrm{n}_{1/2} \to \mathrm{p}_{-1/2} + \mathrm{e}^-_{1/2} + \bar{\nu}_{1/2}$. Similarly, the reaction path for ${}^{58}_{27}\mathrm{Co}_{I=2} \to {}^{58}_{26}\mathrm{Fe}_{I=2}$ is most likely $\left[\mathrm{p}_{1/2} + \gamma_{-1}\right] + \gamma_1 \to \mathrm{n}_{-1/2} + \mathrm{e}^+_{1/2} + \nu_{1/2}$ (where $\left[\mathrm{p}_{1/2} + \gamma_{-1}\right]$ denotes that the photon γ_{-1} comes from the nucleus).

In the decay of ${}^{60}_{27}\mathrm{Co}_{I=5} \to {}^{60}_{28}\mathrm{Ni}_{I=4}$, that e^- tends toward emitting along the direction of the neutron magnetic moment, while the $\bar{\nu}_e$ tends toward radiating in the opposite direction and is right-handed. In the decay of ${}^{58}_{27}\mathrm{Co}_{J=2} \to {}^{58}_{26}\mathrm{Fe}_{J=2}$, that e^+ tends toward emitting along the direction of the proton magnetic moment, while the ν_e tends toward radiating in the opposite direction and is left-handed. Are the characteristic emission directions of the released e^+ and e^- from beta decay genuinely caused by the parity breaking of neutrinos? If a proton can become a neutron by absorbing either of the two neutrinos (high-energy $\bar{\nu}_e$ and ν_e), can it be established that $\bar{\nu}_e$ and ν_e with the same energy are identical particles?

In fact, neutrinos are immune to electromagnetic fields, while the magnetic moment is equivalent to the charge-vorticity flux. Consequently, it must be the parent-nucleon magnetic moment that leads to the emitting direction of the e^+ or e^- released from beta decay. Logically, the radiation direction of neutrinos in beta decay is entirely passively determined by momentum conservation. And for orbital electron capture reactions that do not emit charged particles, take one example, the electron capture in

$${}^{152}_{63}\mathrm{Eu}_{I=0} + \mathrm{e}^- \to {}^{152}_{62}\mathrm{Sm}_{I=1} + \nu_e \quad \left(\Delta I = 1;\ \downarrow \mathrm{p}_{-1/2} + \uparrow \mathrm{e}^-_{1/2} \to \downarrow \mathrm{n}_{1/2} + \uparrow \nu_{-1/2}\right), \tag{12}$$

which is also closely related to the nucleon magnetic moment[3]. Conceivably, one proton (magnetic moment) induces one electron to approach it against its magnetic moment direction, and angular momentum conservation and linear momentum conservation collectively determine the spin and radiation direction of the neutrino.

Technically speaking, neutrinos are not chiral particles but neutral energy particles with zero magnetic moments (no annihilation between neutrinos and antineutrinos). Free neutrinos have no mass since they cannot exhibit standing wave effects in a static gravitational field – neutrino oscillation is primarily caused by the neutrino scattering or absorbing of energy during its journey. From neutrinos are involved in the fission and fusion of many polar particles and have a spin quantum number of 1/2, it is not arduous to deduce that the neutrino should have a neutral spherical-shell structure composed of a pair of superposing negative and positive charge-shells. Naturally, the energy of a neutrino is furnished by the bound-state photon inside its shell.

Now, denoting the negative-positive particle pair constituting the vacuum electromagnetic medium as $\mathrm{e}_{\mathrm{v}}^{\pm}$ (spin 0), one primary way of generating neutrinos (in an ultra-strong magnetic field, such as a proton surface and the eyewall of a black-hole vortex) can be expressed as

$$\mathrm{e}_{\mathrm{v}}^{\pm} + \mathrm{e}_{\mathrm{v}}^{\pm} \to \mathrm{v}_{1/2} + \mathrm{v}_{-1/2}. \tag{13}$$

Of course, as shown in $\mathrm{e}_{\mathrm{v}}^{\pm} \to \mathrm{e}^{-} + \mathrm{e}^{+}$, a single $\mathrm{e}_{\mathrm{v}}^{\pm}$ can also be ionized in an ultra-strong magnetic field (see high-energy collision experiments). Moreover, multiple $\mathrm{e}_{\mathrm{v}}^{\pm}$ can be combined into great-mass (especially unstable) composite particles when subjected to high-energy collisions, which is the root reason why high-speed electron collisions can create other particles. Corresponding to the synthesis of more than 1000 nuclides (most of them are extremely unstable) by electrons and nucleons, it should also be one of the most natural laws of the universe that photons and charges $(\mathrm{e}_{\mathrm{v}}^{+}, \mathrm{e}_{\mathrm{v}}^{-})$ compose hundreds of subatomic particles (most of them are extremely unstable).

The electroweak theory depicts neutron decay as $\mathrm{d}^{-1/3} \to \mathrm{u}^{2/3} + \mathrm{W}^{-1} \to \mathrm{u}^{2/3} + \mathrm{e}^{-1} + \bar{\mathrm{v}}$. In this case, quantum mechanics cannot essentially clarify nucleons' spin and spin magnetic moments, and the data fitting of $m_{\mathrm{W}} \approx 17000 m_{\mathrm{d}} \approx 34000 m_{\mathrm{u}} \approx 85 m_{\mathrm{n}}$ is not much more elegant than the geocentric model. Corresponding to the reversibility of electrons absorbing photons to transition and hydrogen combining with oxygen to form water ($2\mathrm{H} + \mathrm{O} \rightleftharpoons \mathrm{H_2O}$), the reverse reaction of neutron decay ($\mathrm{n}_{1/2} \to \mathrm{p}_{-1/2} + \mathrm{e}_{1/2}^{-} + \mathrm{v}_{1/2}$) should be $\mathrm{p}_{-1/2} + \mathrm{e}_{1/2}^{-} + \mathrm{v}_{1/2} \to \mathrm{n}_{1/2}$. More precisely, the prime pathways (reversible) in which protons synthesize neutrons are

$$\left.\begin{aligned}
&\text{Neutrino absorption: } \left(\mathrm{p}_{-1/2} + \mathrm{v}_{1/2}\right) + \mathrm{e}_{\mathrm{v}}^{\pm} \to \left[\mathrm{p}_{-1/2} + \mathrm{v}_{1/2} + \mathrm{e}_{1/2}^{-}\right] + \mathrm{e}_{-1/2}^{+} \to \mathrm{n}_{1/2} + \mathrm{e}_{-1/2}^{+};\\
&\text{Electron capture: } \left(\mathrm{p}_{-1/2} + \mathrm{e}_{1/2}^{-}\right) + 2\mathrm{e}_{\mathrm{v}}^{\pm} \to \left[\mathrm{p}_{-1/2} + \mathrm{v}_{1/2} + \mathrm{e}_{1/2}^{-}\right] + \mathrm{v}_{-1/2} \to \mathrm{n}_{1/2} + \mathrm{v}_{-1/2};\\
&\beta^{+}: \left(\mathrm{p}_{-1/2} + \gamma_{1} + \gamma_{-1}\right) + 3\mathrm{e}_{\mathrm{v}}^{\pm} \to \left[\mathrm{p}_{-1/2} + \mathrm{v}_{1/2} + \mathrm{e}_{1/2}^{-}\right] + \mathrm{e}_{-1/2}^{+} + \mathrm{v}_{-1/2} \to \mathrm{n}_{1/2} + \mathrm{e}_{-1/2}^{+} + \mathrm{v}_{-1/2}.
\end{aligned}\right\} \tag{14}$$

Of course, experiments have partly verified and will completely confirm that the reversible reactions in these equations mirror the nature of protons and neutrons converting to each other.

§ 3.5 Mass, nucleons, and quarks

The mass of an object is, in essence, nothing more than the (electromagnetic) standing wave effect of its inherent bound-state energy E_0 spinning at the speed of light in a gravitational field, as shown in the mass-energy equation $m_0 = \frac{1}{c^2} E_0$ (independent of space coordinates and time passing). When neutral particles with nonzero magnetic moments travel (spin) at a higher speed, they certainly will carry more temporarily bound-state energy, thus showing the kinematic phenomenon of mass increase – which has long been verified by the charge-mass ratio of electrons.

Nucleons (protons and neutrons) are composite particles possessing a complex and stable structure that can steadily imprison constant energy (equivalent to mass in a gravitational field). The charged radius of protons is $r_{\mathrm{p}} \approx 4 \frac{\hbar}{m_{\mathrm{p}} c}$ (ignoring measurement bias influenced by experimental conditions), and its average internal pressure (energy density) is

$$P_{\mathrm{p}} \approx \frac{m_{\mathrm{p}}c^2}{4\pi r_{\mathrm{p}}^3/3} \approx 3.76 \times 10^{53}\ \mathrm{eV} \cdot \mathrm{m}^{-3} \approx 6 \times 10^{34}\ \mathrm{Pa} \approx 6 \times 10^{29}\ \mathrm{atm}. \tag{15}$$

This value is consistent with experimental data, confirming the fluid characteristics of energy space. Furthermore, the experiment demonstrates that the proton's central pressure is outward and that its surrounding region generates inward pressure[4], indicating the proton must have a charge-stratified-nested spherical-shell structure. Can the charged shell of protons without high-energy collisional distortion be considered a natural valence quark in a low-energy state?

Since the magnetic moment is equivalent to the angular momentum of electric charges, the proton spin magnetic moment naturally arises from the regular motion of its charged constituents. Accordingly, the so-called nuclear magneton $\mu_{\mathrm{N}} = \frac{e\hbar}{2m_{\mathrm{p}}}$ is just a mathematical imitation of the Bohr magneton induced by the electron spin; after all, the charge-spin form of the proton is different from that of the electron.

Now we know that collisions of near-light-speed electrons and positrons can generate leptons, mesons, and baryons but no quarks that are essential constituents of mesons and baryons. Furthermore, all the mesons and baryons (except nucleons) generated in high-energy collision experiments will inevitably decay swiftly into two or more kinds of stable particles—including neutral particles (i.e., neutrinos, photons, and virtual electron pairs) and charged particles (such as electrons and protons, but no quarks). Evidently, not only is the origin of quarks mysterious, but in any case, they cannot constitute composite particles with a fractional charge.

Logically, the fractional charge of elementary particles is redundant to nature. It is perfectly reasonable to correct valence quarks to particles carrying an elementary charge and correct quark-antiquark pairs to bound-state negative-positive virtual electron pairs. Naturally, gluons can be considered bound-state photons, and all non-photon particles necessarily consist of electric charges and bound-state photons. (In the *Opticks* [Question #30], Newton reasoned that the changing of matter into light and light into matter "is very conformable to the Course of Nature".)

One possible charge structure of a proton is composed of a spherical shell with two positive elementary charges ($2\mathrm{e}^+$) and a spherical core with one negative elementary charge (e^-), whose regular high-speed rotations contribute almost all the proton's spin magnetic moment. In this case, the proton magnetic moment (ignoring relevant coupling factors) can be approximated as

$$\begin{aligned} \mu_{\mathrm{p}} &\approx \frac{1}{2}\left[\frac{2}{3}\left|\boldsymbol{r}_{\mathbf{p}} \times (2e)\frac{1}{2}\boldsymbol{c}\right| + \frac{2}{3}\left|\frac{\sqrt{3}}{8}\boldsymbol{r}_{\mathbf{p}} \times (-e)\frac{\sqrt{3}}{8}\boldsymbol{c}\right| + \left|\frac{\alpha}{8\pi}\boldsymbol{r}_{\mathbf{p}} \times e\boldsymbol{c}\right|\right] \\ &= \left(\frac{8}{3} + \frac{1}{8} + \frac{\alpha}{2\pi}\right)\frac{e\hbar}{2m_{\mathrm{p}}} \approx 2.792\,828\ \mu_{\mathrm{N}} \approx 0.999\,993\ \mu_{\mathrm{p}}^{EXP}, \end{aligned} \tag{16}$$

where $\left|\frac{\alpha}{8\pi}\boldsymbol{r}_{\mathbf{p}} \times e\boldsymbol{c}\right| = \frac{\alpha}{2\pi}\mu_{\mathrm{N}}$ should be contributed by the self-energy oscillation of the proton. Of course, the charge structure of a proton can be roughly ascertained by measuring the magnetostatic field around it (about $\frac{2}{3}\frac{r_{\mathrm{p}}^3}{R^3}\frac{\mu_0 ec}{4\pi r_{\mathrm{p}}^2}$ at its polar axis, and half that on the equatorial plane).

Considering that high-speed particles dashing into a high-density incompressible fluid are subjected to strong impact forces and near-light-speed electron collisions can produce composite particles, it can be inferred that the neutron's spontaneous decay $\mathrm{n}_{1/2} \rightarrow \mathrm{p}_{-1/2} + \mathrm{e}^- + \bar{\nu}_{\mathrm{e}}$ should reflect the natural composition of neutrons more factually than high-energy collision experiments. Since r_{e} is greater than $3r_{\mathrm{p}}$ and the charge is an elastic spherical shell that can be penetrated, the proton is most likely to convert into a neutron by occupying an electron's interior rather than swallowing the electron whole. It is conceivable that a neutron consists of a negative-charge shell, an internal proton, and a certain amount of bound-state energy. The charged outer shells have opposite polarity, fundamentally determining that protons and neutrons can be glued together at close distances less than r_{e}. Note that the spin of nucleons is primarily contributed by their internal constituents—moving nucleons do not have to comply with $|\boldsymbol{r} \times m\boldsymbol{v}| = \hbar$, which is one of the main reasons why macroscopic matter can stay static.

From electrodynamics, it can be inferred that the electromagnetic energy of the neutron's charge shell is $(m_{\mathrm{n}} - m_{\mathrm{p}})c^2$, and its charge radius is $r_{\mathrm{n}} \approx \frac{m_{\mathrm{e}}}{m_{\mathrm{n}} - m_{\mathrm{p}}} r_{\mathrm{e}}$. Thus, the outer-charge-shell and the inner-proton jointly contribute to the neutron's magnetic moment, which approximates

$$\mu_{\mathrm{n}} \approx -\left|\mu_{\mathrm{p}} - \frac{1}{2}\left(\frac{2}{3} k r_{\mathrm{n}} e c\right)\right| \approx \mu_{\mathrm{p}} - \frac{4}{9} r_{\mathrm{n}} e c \approx -1.91293\, \mu_{\mathrm{N}} \approx 0.99994\, \mu_n^{EXP}. \tag{17}$$

Of course, there is also a theoretical possibility of $\mu_{\mathrm{n}} \approx -\mu_{\mathrm{p}} + k r_{\mathrm{n}} e c$, which can likewise be investigated by further measuring the magnetic field around neutrons.

The truth is that the Standard Model of particles has not radically clarified composite particles' essential structure and elementary constituents, nor has it elucidated the nature of mass and gravitation. More likely, the root of this dilemma is that many theoretical physicists are keen on high-energy collision experiments and mathematical tricks while neglecting to probe a few fundamental issues such as spin pictures and vacuum fluids.

§ 3.6 Vacuum quantization and fundamental interactions

A vacuum is a ground-state space. Moreover, the vacuum is also an electromagnetic medium that consists of virtual electrons and possesses constant permittivity and permeability. All virtual electrons are paired in a negative-positive combination (unless ionized). Any two paired virtual electrons spin oppositely at the speed of light, thus forming a vortex-like *LC* circuit rather than the superstring (permittivity is closely related to the oscillating frequency of media). Theoretically, this *LC* circuit, which has no discrete energy levels and can store energy, should be one of the main components of dark matter (including superfluid-state hydrogen). Additionally, virtual electrons must be the charge source and energy shell (akin to the cell wall) of all non-photon particles.

Similarly, the vacuum is simultaneously a gravitational medium composed of gravitons. Since gravitation always points to the object's centroid and the energy density $w_G = -\frac{1}{8\pi G}(E_G^2 + B_G^2)$ of gravitational fields obtained by imitating the formula for the electromagnetic field's energy density is also negative, the energy density of the gravitational medium should be a negative extremum. From $\frac{GMm}{r} = mc^2 = \frac{rmc^2}{r} = -\frac{\hbar c}{r} \Rightarrow m_{\mathrm{min}} = -M = -\sqrt{\frac{\hbar c}{G}} = -M_{\mathrm{P}}$, we can derive that the energy of graviton that can neither annihilate nor dissipate is $-M_{\mathrm{P}} c^2$. Conceivably, the energy density of a gravitational medium is partly neutralized by its resonance with an object's energy carriers, and the gradient of the negative energy density around the object inevitably presents a centripetal gravitational field. Of course, the gravitational medium will also exhibit strong gravitational fields if its density can become marginally lower in galaxies.

Logically, gravitons distributed homogeneously are in pairs, and the two paired gravitons spin at the speed of light in the same direction to form vortices rather than superstrings. Gravitons have the minimum dimension $r_{\mathrm{g}} = l_{\mathrm{P}} = \sqrt{\frac{G\hbar}{c^3}}$ and are densely distributed, thus constituting an incompressible, isotropic, homogeneous three-dimensional space (absolute Newtonian space). In a vacuum, the zero-point energy density is approximately

$$w_0 \approx \frac{m_{\mathrm{g}}c^2}{4\pi l_{\mathrm{P}}^3/3} = -\frac{M_{\mathrm{P}}^6}{m_{\mathrm{e}}^2 m_{\mathrm{p}}^4} w_{\mathrm{U}} \approx -6.9 \times 10^{131}\ \mathrm{eV} \cdot \mathrm{m}^{-3}. \tag{18}$$

Although quantum field theory works out the order of magnitude of the zero-point energy[5] agreed with w_0, it omits the minus sign by not comprehending that space-medium energy is negative.

As shown in Newton's second law $\boldsymbol{F} = \frac{\mathrm{d}\boldsymbol{p}}{\mathrm{d}t} = \frac{\mathrm{d}(\rho V c)}{\mathrm{d}t}\vec{\boldsymbol{e}} = \frac{\mathrm{d}[\rho(Act)c]}{\mathrm{d}t}\vec{\boldsymbol{e}} = \rho c^2 \boldsymbol{A} = \oiiint \nabla P\, \mathrm{d}V$, fundamental interactions arise from the energy-density gradient of the medium and are transmitted by the momentum of medium particles excited by interacting objects,. Accordingly, gravitational force $\boldsymbol{F_G}$, Coulomb force $\boldsymbol{F_C}$, and Lorentz force $\boldsymbol{F_L}$ can be expressed as

$$\left.\begin{aligned} \boldsymbol{F_G} &= \rho c^2 \boldsymbol{A} = -\frac{Mc^2}{4\pi r^3/3}\left(\frac{4\pi r}{3}\frac{Gm}{c^2}\right)\vec{\boldsymbol{e}} = -\frac{GMm}{r^2}\vec{\boldsymbol{e}} \quad \left(r \gg \frac{Gm}{c^2}\right), \\ \boldsymbol{F_C} &= \rho c^2 \boldsymbol{A} = \frac{\frac{q_1}{e} m_{\mathrm{e}} c^2}{4\pi r^3/3}\left[\frac{4\pi r}{3}\left(\frac{q_2}{e}\frac{\alpha\hbar}{m_{\mathrm{e}}c}\right)\right]\vec{\boldsymbol{e}} = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2}\vec{\boldsymbol{e}} \ (r \gg r_{\mathrm{e}}), \\ \boldsymbol{F_L} &= \rho c^2 \boldsymbol{A} = (\mu_0 H^2)\left[\frac{q_m/4\pi\mu_0 r^2}{H}(4\pi r^2)\right]\vec{\boldsymbol{e}} = q_m H\vec{\boldsymbol{e}} = \mu_0 q\boldsymbol{v} \times \boldsymbol{H}. \end{aligned}\right\} \tag{19}$$

Since every object is dragging its potential field synchronously at any instant (akin to a point charge always carrying its electrostatic field), the area $\boldsymbol{A}$ in the above equations is the effective stressed area of the potential field of the object.

As we know, the electric field lines of a point charge are akin to ray-family streamlines, and the magnetic induction lines around a line-current are comparable to the concentric-circles vortex filaments with the wire as the axis. Comparing the force direction between point charges and the force direction between parallel currents, it can be inferred that the electrostatic force results from the tangential stress of electromagnetic media, and the magnetic force arises from the normal stress of electromagnetic media. Similarly, the strong interaction (including asymptotic freedom) can be understood more intuitively from the perspective of continuum mechanics (note the circular spin of elementary particles and the pairing of quark-antiquark with spherical charges).

Imitating the electric flux $\Phi_E = q/\varepsilon_0$, we have the magnetic flux $\Phi_H = q_m/\mu_0$ and the gravitational flux $\Phi_G = -4\pi mG$. Accordingly, the Fundamental forces can be expressed as

$$\boldsymbol{F} = \Phi\sigma\vec{\boldsymbol{e}} \quad \left(\sigma = \frac{X}{4\pi r^2},\ X \in \{Q, Q_m, M\}\right). \tag{20}$$

For example, Lorentz's force is $\boldsymbol{F_L} = \Phi_H \sigma_m \vec{\boldsymbol{e}} = \frac{q_m}{\mu_0}\frac{Q_m}{4\pi r^2}\vec{\boldsymbol{e}} = q_m \frac{Q_m}{4\pi\mu_0 r^2}\vec{\boldsymbol{e}} = \mu_0 q\boldsymbol{v} \times \boldsymbol{H}$.

In physics, flux is defined as the amount of fluid, particles, or energy across a given surface per unit time. Considering $\Phi_H = \frac{q_m}{\mu_0} = qv = \frac{q\mathrm{d}l}{\mathrm{d}t}$ (like an electric dipole moment flux) as the flux of virtual electron pairs and $\Phi_G = -4\pi mG = -4\pi\frac{m}{M_{\mathrm{P}}}\frac{2\pi l_{\mathrm{P}}^2 c}{T_{\mathrm{P}}}$ as the flux of gravitons, we see that the electric flux $\Phi_E = \frac{q}{\varepsilon_0}$ should be the charge flux of virtual electron pairs. Subsequently, the unit of permittivity can be reduced to the time unit, which is consistent with its close correlation with the medium's oscillating frequency and matches the definition of flux. Thus, vacuum permittivity ε_0 should be the oscillating period of the vacuum LC circuit composed of virtual electron pairs:

$$\varepsilon_0 = 2\pi\sqrt{L_0 C_0} = 2\pi C_0\sqrt{\frac{L_0}{C_0}} = 2\pi C_0 R_{\mathrm{K}}. \tag{21}$$

According to $e = \sqrt{\alpha(4\pi\varepsilon_0 c\hbar)}$ and $\mu_0 ec = \frac{e}{\varepsilon_0 c}$, we can get $1\,\mathrm{C} = 1\sqrt{\mathrm{kg}\cdot(\mathrm{m/s})}\cdot\mathrm{m}$ and $1\,\mathrm{Wb} = 1\sqrt{\mathrm{kg}\cdot(\mathrm{m/s})}$. Moreover, the temperature of the vacuum medium is approximated as

$$T_0^{\mathrm{vac}} \approx \frac{1}{k}\left(\frac{1}{2}\frac{h}{\varepsilon_0}\right) \approx 2.71\,\mathrm{K}. \tag{22}$$

Considering $T_0^{\mathrm{vac}} \approx \frac{1}{k}\left(\frac{1}{2}\frac{h}{\varepsilon_0}\right) \approx \frac{1}{2}(\mu_0 ec)c^2$ and that sensing temperature is closely related to the electromagnetic properties (high-energy neutrinos moving densely in all directions have no temperature), we can infer that the temperature unit should be $1\,\mathrm{K} = 1\,\mathrm{Wb}\cdot(\mathrm{m/s})^2$. Accordingly, the Boltzmann constant (CODATA recommended $k = 1.380649 \times 10^{-23}\,\mathrm{J}\cdot\mathrm{K}^{-1}$) approximates

$$k \approx \frac{h}{ec}\left(1 + \frac{1}{2}\sqrt{\frac{a_0}{\alpha c\varepsilon_0}}\right) \approx 1.380\,650 \times 10^{-23}\,\mathrm{J}\cdot\mathrm{K}^{-1} \quad \left(1\,\mathrm{J}\cdot\mathrm{K}^{-1} = 1\,\mathrm{Wb}\cdot\mathrm{s}\cdot\mathrm{m}^{-1}\right). \tag{23}$$

Up to this point, all physical units can already be expressed by different combinations of three base units in the energy unit.

Additionally, the vacuum is a homogeneous, isotropic linear medium consisting of invisible particles (gravitons and virtual electrons) that move at the speed of light ($c^2 = (\frac{\mathrm{d}x}{\mathrm{d}t})^2 = \frac{\partial x^2}{\partial t^2}$). Thus, the waves vibrating in vacuum media satisfy

$$\frac{\partial^2 f(x,t)}{\partial x^2} = \frac{1}{c^2}\frac{\partial^2 f(x,t)}{\partial t^2}. \tag{24}$$

Naturally, both gravitational and electromagnetic fields in a vacuum follow this formula when transferring energy.

IV. Conclusions

By analyzing the classical counterpart of an elementary particle spin, this study revealed the vortex properties of magnetic moments, the essence of beta decay, the structure of neutrinos and nucleons, the basic constituents of all particles, and the quantization of the vacuum. This paper can be considered a blueprint of the Theory of Everything (TOE), which will advance physicists to research particles, galaxies, and even black holes from the viewpoint of Newtonian particle dynamics and fluid mechanics (especially vortex theory).

Acknowledgments

I am grateful to myself for the specialized reading and independent thinking over the past year. I am also thankful that Newton's physical thoughts still resonate with me today. In addition, I have been inspired by Planck's efforts to incorporate quantum theory into classical mechanics, and I have been motivated by some topping physicists (e.g., Einstein, Schrödinger, and Dirac) dissatisfied with quantum mechanics.

References

Note: All references that are easily found in college physics textbooks are not listed.

[1] Isaac Newton, Opticks or, a Treatise of the Reflections, Refractions, Inflections, and Colours of Light, 278-281, the Project Gutenberg eBook #33504

[2] Roy A. Briere, Frederick A. Harris, and Ryan E. Mitchell, Physics Accomplishments and Future Prospects of the BES Experiments at the Beijing Electron--Positron Collider, Annu. Rev. Nucl. Part. S. 66, 143-170 (2016)
DOI: 10.1146/annurev-nucl-102115-044802

[3] M. Goldhaber, L. Grodzins, and A. W. Sunyar, Helicity of Neutrinos, Phys. Rev. 109, 1015-1017 (1958)
DOI: 10.1103/PhysRev.109.1015

[4] P. E. Shanahan and W. Detmold, Pressure Distribution and Shear Forces inside the Proton, Phys. Rev. Lett. 122, 072003 (2019)
DOI: 10.1103/PhysRevLett.122.072003; e-Print: 1810.07589

[5] J. A. Wheeler and C. Misner, Geometrodynamics, Academic Press, New York, 1962.