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N/A

Article

Keywords: quantum phenomena, universal classical theory, particle structure

Posted Date: December 1st, 2021

DOI: https://doi.org/10.21203/rs.3.rs-1116117/v2

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

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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. This paper can be considered a blueprint of the Theory of Everything (TOE).

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 $\mu_{\mathrm{N}} = \frac{e\hbar}{2m_{\mathrm{p}}}$, although it is only predicted by imitating the magnetic moment (Bohr magneton) $\mu_{\mathrm{B}} = \frac{e(\alpha c/n)}{2\pi(na_0)}[\pi(na_0)^2] = \frac{e[a_0 m_{\mathrm{e}}(\alpha c)]}{2m_{\mathrm{e}}} = \frac{e\hbar}{2m_{\mathrm{e}}}$ resulting from an electron in a circular motion. 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 signify 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 is 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 $\mu_{\mathrm{B}} = \frac{e(\alpha c/n)}{2\pi(na_0)}[\pi(na_0)^2] = \frac{1}{2}\left|n\boldsymbol{a_0} \times e\frac{\alpha \boldsymbol{c}}{n}\right|$ is akin to the coil-current magnetic moment and charge-revolving angular momentum (disregarding electron clouds for now). Moreover, at different energy levels of hydrogen atoms, the electron spin satisfying $na_0 m_{\mathrm{e}}\frac{\alpha c}{n} = \hbar \Rightarrow |\boldsymbol{r_\Omega} \times m_{\mathrm{e}}\boldsymbol{v}| = \hbar$ also implies that the mass center of the electron moves in a circular motion. For a photon, considering that both its wavelength and its diffractive ability are negatively correlated to its frequency, and that its circular polarization appears like spiral motion, 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 electron spin obeys $r_\Omega m_e v = \hbar$, its spin quantum number $\frac{1}{2}$ should be caused by the spin-vortex-surface polarization tension or spin magnetic moment nullifying half of its mass-spin angular momentum: $|\boldsymbol{S}_\mathbf{e}| = \frac{1}{2} r_\Omega m_e v = \frac{1}{2}\hbar$. For an electron moving at a near-light speed in a vacuum, its de Broglie wavelength ($\lambda = 2\pi r_\Omega$) will be shorter; hence, the mass m_e in formula $r_\Omega m_e v = \hbar$ 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 a vacuum particle (see §3.6) that their spins are not in the same plane. Assuming that the angle between an electron's initial spin and a new external magnetic field is a random θ ($0 \le \theta \le \pi$), the spin-projection changed amount $S_e(1 \pm \cos\theta)$ of the electron determines its spin-orientation statistical probability

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

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 electrons' identity, which can also be considered a phenomenon in line with classical theory.

As for so-called quantum entanglement, its essence is nothing more than the correlation of independent measurement results between particles whose spin angular momenta before measurement have strong symmetries (e.g., parallel, and antiparallel). For example, the spins of spin-symmetric electrons tend to remain spin-symmetric when 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 a space (vacuum) superfluid, written in the integral form as

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

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 ($mc^2\Omega A_T$), closely related to the unipolar directivity of the same fundamental interaction (energy flowing): For example, a little rooster hatches from an egg, then the little rooster grows into a big rooster, but this sequence must never be reversed.

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 the existence of the ether, and experiments have long proven that the vacuum is non-empty. Accordingly, the superfluid properties (§3.6) of 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 tension of electrons and the stereoscopic 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:

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

Substituting the relevant experimental data (from NIST) gives $\left|\left(E_2-E_2^{EXP}\right)/E_2^{EXP}\right|\approx 5.4\%$, $\left|\left(E_{20}-E_{20}^{EXP}\right)/E_{20}^{EXP}\right|\approx 0.14\%$, and $\left|\left(E_{30}-E_{30}^{EXP}\right)/E_{30}^{EXP}\right|\approx 0.70\%$... 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 that participates in expressing many properties of macroscopic matter such as shapes, colors, temperature, and binding energy. For a free electron ($rm_\mathrm{e}v=\hbar$), $\frac{h}{e}=\oint_0^{2\pi r_\Omega}\frac{m_\mathrm{e}}{e}v\,\mathrm{d}l=\iint_0^{\pi r_\Omega^2}\frac{m_\mathrm{e}}{e}\Omega\,\mathrm{d}A$ depicts both spin-speed circulation and spin-vorticity flux. Correspondingly, Cooper pair magnetic flux can be expressed as $\Phi_0=2\iint_0^{\pi\left(\frac{r}{4}\right)^2}\left|\boldsymbol{\nabla}\times\frac{m_\mathrm{e}}{e}\boldsymbol{v}\right|\mathrm{d}A=2\oint_0^{2\pi\frac{r}{4}}\frac{m_\mathrm{e}}{e}v\,\mathrm{d}l=\frac{2\pi r m_\mathrm{e}v}{2e}=\frac{h}{2e}$, 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 or natural phenomena. We will discuss the following six aspects: (§3.1) spin magnetic moments; (§3.2) electron structure; (§3.3) Muon structure and time dilation; (§3.4) neutrino chirality and beta decay; (§3.5) mass, nucleons, and quarks; (§3.6) 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

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

indicating that the spin magnetic moment is the charge-spin angular momentum and is equivalent to the charge-speed circulation or the charge-vorticity flux. Therefore, spin magnetic moments totally can be articulated by the regular motion of charges, without bothering too much about the mass of particles (especially 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 centroid spin. More likely, the spin-vortex of a near-light-speed electron can pairwise induce negative-positive polarization charges (see §3.6) that spin contrarily to maintain the spin magnetic moment. Since near-light-speed electron collisions can produce the mesons and hadrons generated in high-energy proton collisions[2] (which will eventually be fully verified), measuring the magnetostatic fields around polar particles has the equivalent experimental value as large collider experiments.

Experiments have long 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

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

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.

The so-called anomaly of spin magnetic moments is the anomaly relative to an inaccurate theoretical prediction; actually, it is precisely the most normal phenomenon governed by the laws of nature. Conceivably, the cyclical spin of charges is accompanied by other regular motions, thus causing the magnetic moment anomaly of polar particles to approximate constants. Moreover, the scattering cross-section and charge radius of particles with nonzero magnetic moments indicate that the elementary charge necessarily has a well-regulated structure, which is also the experimental fact that re-examines the composition 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?

As we know, the annihilation of particle-antiparticle pairs necessarily releases photons, and the mass loss Δm_0 in nuclear reactions certainly will convert into energy $\Delta m_0 c^2$. Further, considering the mass-energy equation $E = m_0 c^2$ and the decay of neutral mesons (e.g., $\pi^0 \to 2\gamma$, or $\pi^0 \to \gamma + e^- + e^+$, or even $\pi^0 \to e^- + e^+ + e^- + e^+, \ldots$), 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 are bound to 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 the electron and positron (symmetrical monopole virtual electrons) from the vacuum.

Up to now, the precise charge radius of electrons (sensitive to measuring parameter, in fact) 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, while the charge of an electron is furnished by its shell carrying an elementary charge, its mass $m_e = \frac{1}{c^2}\frac{GM_P^2}{\lambda_C} = \frac{1}{c^2}\frac{e^2}{4\pi\varepsilon_0 r_e}$ is contributed by a bound-state photon inside the shell as an energy standing wave in a gravitational field. In addition, the root reason why an 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 $2\pi r_c$ of the cycloid is just the charge-radius r_e at which the electron's electromagnetic energy converges to $m_e c^2 = \frac{1}{2}\frac{e^2}{4\pi\varepsilon_0 r_e} + \frac{1}{2}\frac{(\mu_0 e c)^2}{4\pi\mu_0 r_e} = \frac{e^2}{4\pi\varepsilon_0 r_e}$. (Such a direct relation is only applicable to charged leptons; the elementary charge is a basic, extraordinary, indivisible, and indestructible spherical shell that is far more exquisite than the cell wall.)

The contribution of the electron self-energy oscillation to its spin magnetic moment is

$$\mu_e' = -\frac{1}{2}|\boldsymbol{r}_c \times e\boldsymbol{c}| = -\frac{1}{2}\frac{r_e e c}{2\pi} = -\frac{1}{2\pi}\frac{e r_e m_e c}{2 m_e} = -\frac{\alpha}{2\pi}\mu_B, \tag{7}$$

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

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 the charge-shell rotating in the opposite direction to the electron spin that causes the electron magnetic moment anomaly to be less than $\frac{\alpha}{2\pi}$. From the classical mechanical perspective, the electron magnetic moment anomaly can be expressed as $a_e = \frac{1}{a_0 \alpha c}\left(|\boldsymbol{r}_c \times \boldsymbol{c}| - \frac{2}{3}|\boldsymbol{r}_e \times \boldsymbol{v}|\right)$ – the relevant correction term also needs to consider only the regular motion of the charge (including polarized charges) in a vacuum electromagnetic medium.

§ 3.3 Muon structure and time dilation

Muons possess electromagnetic properties remarkably akin to electrons. However, the muon is extremely unstable (with an average lifetime of only 2-μs), which will spontaneously decay into an electron and release energy in the form of neutrinos. Accordingly, the muon can be considered a composite electron with a higher-energy magnitude (it transitions without releasing photons). Another difference from the electron is that the muon magnetic moment anomaly exceeds $\frac{\alpha}{2\pi}$; hence 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? Observed within the earth's Hill sphere, if two reference frames have the same centripetal acceleration relative to the earth's center, why is there no time dilation between them no matter how large the relative speed between them is? Moreover, for the atomic clock on satellites, why can its timing period be expressed as the acceleration relation $T_{GPS} \approx \frac{cT_\oplus}{\sqrt{c^2-2(R_G g_G-R_\oplus g_0)-R_G a}} = \frac{T_\oplus}{\sqrt{1-(3R_G g_G-2R_\oplus g_0)/c^2}}$?

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 particles' cyclical motion (e.g., decay, transition) in different accelerated states (including spin centripetal acceleration). As shown in the Hafele-Keating experiment and the timing period of the atomic clock on 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

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

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

For a given muon, its internal energy particles will scatter from the specific exit of the equipotential field inside its charge shell while moving a corresponding fixed distance relative to its rotating spin-vorticity field, 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 only the speed of light in the observer's static vacuum. Moreover, Fizeau's empirical formula $c_n = \frac{c-v/n}{n} + v$ totally can illuminate the constancy of the speed of light in the vacuum ($n = 1$) from the perspective of Galilean transformation. (The vacuum dragged by an observer does not impact on the measured speed of light for another observer.)

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 (bound in its electromagnetic spin-vorticity field) should be

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

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 (Lorentz transformation is a rotation related to particles' spin-vorticity field), 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 equivalence between magnetic moments and charge vorticity flux.) 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 neutrino $\bar{\nu}_e$:

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

where the subscript of the nucleon denotes the spin quantum number and spin direction. Experiments demonstrate that the energy spectrum of β^- (e^-) rays is continuous, while the corresponding energy of neutrino $\bar{\nu}_e$ 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):

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

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 parent-neutron magnetic moment, while the $\bar{\nu}_e$ tends toward radiating in the opposite direction and is right-handed. In the decay of ${}^{58}_{27}\mathrm{Co}_{I=2} \to {}^{58}_{26}\mathrm{Fe}_{I=2}$, that e^+ tends toward emitting along the direction of the parent-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 whether it absorbs $\bar{\nu}_e$ or 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[3], the electron capture in

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

which is also closely related to the nucleon magnetic moment. 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 created neutrino.

Technically speaking, neutrinos are not chiral particles but neutral energy particles with zero magnetic moments (almost 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 energy during its journey. Since neutrinos are involved in the fission and fusion of many polar particles and have a spin quantum number of 1/2, it can be inferred 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 virtual electron pair ($e^+_v + e^-_v$) constituting the vacuum electromagnetic medium as $e^\pm_v$ (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

$$e^\pm_v + e^\pm_v \to \nu_{1/2} + \nu_{-1/2}. \tag{13}$$

Of course, as shown in $e^\pm_v \to e^- + e^+$, a single $e^\pm_v$ can also be ionized in an ultra-strong magnetic field (see high-energy collision experiments). Moreover, multiple $e^\pm_v$ 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 that more than 1000 types of nuclides (most of them extremely unstable) can be synthesized by electrons and nucleons, it must also be one of the most natural laws of the universe that photons and charges (e^+_v, e^-_v) compose hundreds of subatomic particles (most of them extremely unstable).

The electroweak theory depicts neutron decay as $d^{-1/3} \to u^{2/3} + W^{-1} \to u^{2/3} + e^{-1} + \bar{\nu}$. In this case, quantum mechanics cannot essentially clarify nucleons' spin and spin magnetic moments, and the data fitting of $m_W \approx 17000 m_d \approx 34000 m_u \approx 85 m_n$ 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 ($2H + O \rightleftharpoons H_2O$), the reverse reaction of neutron decay ($n_{1/2} \to p_{-1/2} + e^-_{1/2} + \nu_{1/2}$) should be $p_{-1/2} + e^-_{1/2} + \nu_{1/2} \to n_{1/2}$. More precisely, the prime pathways (reversible) for synthesizing neutrons from protons are

$$\left.\begin{array}{l}
\text{Neutrino absorption: } \left(p_{-1/2} + \nu_{1/2}\right) + e^\pm_v \to \left[p_{-1/2} + \nu_{1/2} + e^-_{1/2}\right] + e^+_{-1/2} \to n_{1/2} + e^+_{-1/2};\\
\text{Electron capture: } \left(p_{-1/2} + e^-_{1/2}\right) + 2e^\pm_v \to \left[p_{-1/2} + \nu_{1/2} + e^-_{1/2}\right] + \nu_{-1/2} \to n_{1/2} + \nu_{-1/2};\\
\beta^+ : \left(p_{-1/2} + \gamma_1 + \gamma_{-1}\right) + 3e^\pm_v \to \left[p_{-1/2} + \nu_{1/2} + e^-_{1/2}\right] + e^+_{-1/2} + \nu_{-1/2} \to n_{1/2} + e^+_{-1/2} + \nu_{-1/2}.
\end{array}\right\} \tag{14}$$

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 a particle with nonzero magnetic moment travels (spins) at a higher speed, it certainly will carry more temporary bound-state energy, thus showing the kinematic phenomenon of mass increase. The charge-mass ratio of electrons has long verified this point.

Nucleons (protons and neutrons) are composite particles possessing a complex and stable structure that can steadily imprison constant energy (equivalent to mass in gravitational fields). 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[4], 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, indicating the proton must have a charge-stratified-nested spherical-shell structure.

In fact, the charge stratification of nucleons has been experimentally verified[5]. Note that the polarization effect of charges in highly dense dielectrics is not negligible and that the spherical-shell charge shape is sensitive to the experimental energy of magnitude. Can the charge-shell without high-energy collisional distortion inside protons be considered the natural-state valence quark with a well-regulated structure?

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 circular spin of electrons; after all, the charge-spin form of protons is different from that of electrons.

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 (final states) stable particles—including neutral particles (i.e., neutrinos, photons, and virtual electron pairs) and charged particles (i.e., electrons and protons, but no quarks). Evidently, the so-called quarks not only are impossible to form composite particles with a fractional charge under any circumstances, but they have no theoretically sensible source.

Logically, the fractional charge of elementary particles is redundant to nature. It is perfectly reasonable to correct valence quarks to high-energy unipolar virtual electrons 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. (As early as in "Opticks" [Ques. 30], Newton reasoned that the changing of matter into light and light into matter "is very conformable to the Course of Nature".)

As we know, high-speed objects will be subjected to strong impact forces when dashing into a high-density incompressible fluid, and near-light-speed electrons colliding can produce composite particles. Thus, it can be inferred that the neutron's spontaneous decay $\mathrm{n}_{1/2} \to \mathrm{p}_{-1/2} + \mathrm{e}^- + \bar{\nu}_\mathrm{e}$ should reflect the natural composition of neutrons more factually than high-energy collision experiments. Moreover, because 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 charge stratification of neutrons is negative-positive-negative from the outside to the inside[5], indicating that protons must have a positive-charge outer shell (see below for its internal structure).The charged outer shells have opposite polarity, fundamentally determining that a proton and a neutron can be glued together at close distances less than r_e. Note that the spin of a nucleon is primarily furnished by its 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 still.

From electrodynamics (no strong interactions), it can be derived that the neutron's charged outer shell has the electromagnetic energy $(m_\mathrm{n} - m_\mathrm{p})c^2$, 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 and the inner proton jointly contribute to the neutron's magnetic moment

$$\mu_\mathrm{n} \approx -\left|\mu_\mathrm{p} - \frac{1}{2}\left(\frac{2}{3}kr_\mathrm{n}ec\right)\right| \approx \mu_\mathrm{p} - \frac{4}{9}r_\mathrm{n}ec \approx -1.91293\,\mu_\mathrm{N} \approx 0.99994\,\mu_n^{EXP}. \tag{16}$$

Of course, there is also a theoretical possibility of $\mu_\mathrm{n} \approx -\mu_\mathrm{p} + kr_\mathrm{n}ec$. Since the proton inside a neutron can produce induced charges on the outer spherical equipotential surface of the neutron, the neutron magnetic moment should contain the contribution of induced charges. As for the exact charge distribution of neutrons, it is indispensable to measure the magnetostatic field around neutrons, besides continuing various collision experiments.

The proton magnetic moment (ignoring relevant coupling factors) can be fitted as

$$\begin{aligned}\mu_\mathrm{p} &\approx \frac{1}{2}\left[\frac{2}{3}(r_\mathrm{p}ec) + \frac{2}{3}\left(\frac{3}{64}r_\mathrm{p}ec\right) + \left(\frac{\alpha}{8\pi}r_\mathrm{p}\right)ec\right] \\ &= \left(\frac{8}{3} + \frac{1}{8} + \frac{\alpha}{2\pi}\right)\frac{e\hbar}{2m_\mathrm{p}} \approx 2.792\,828\,\mu_\mathrm{N} \approx 0.999\,993\,\mu_\mathrm{p}^{EXP},\end{aligned} \tag{17}$$

where $\frac{2}{3}(r_\mathrm{p}ec) + \frac{2}{3}\left(\frac{2}{64}r_\mathrm{p}ec\right)$ is contributed by the rotation of the spherical-shell charges, while $\left(\frac{\alpha}{8\pi}r_\mathrm{p}\right)ec = \frac{\alpha}{2\pi}\mu_\mathrm{N}$ is furnished by the spin of the charged inner core or the proton's centroid (self-energy). Considering the stable pressure distribution and regular polarization effect inside a proton (disregarding charge-shell deformation in high-energy experiments), we can infer that the charge stratification of protons from outside to inside is probably positive-negative-positive ($-e$ is closer to the inner e) or positive ($2e$)-negative ($-e$). Readily, the charge structure could be roughly ascertained by measuring the magnetostatic field around a proton (about $\frac{2}{3}\frac{r_\mathrm{p}^3}{R^3}\frac{\mu_0 ec}{4\pi r_\mathrm{p}^2}(1+k)$ at its polar axis and half that on the equatorial plane).

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 an electromagnetic medium composed 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 in reverse 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 are precisely the charge source and energy shell (akin to cell walls) of all non-photon particles.

Simultaneously, the vacuum is also 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 $\frac{GMm}{r} = mc^2 = \frac{rmc^2}{r} = -\frac{\hbar c}{r} \Rightarrow m_{\min} = -M = -\sqrt{\frac{\hbar c}{G}} = -M_{\mathrm{P}}$, 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, thus inevitably presenting a centripetal gravitational field by the gradient of the negative energy density around the object. Of course, the gravitational medium will likewise exhibit strong gravitational fields if its density can become marginally lower in galaxies.

Logically, gravitons distributed homogeneously should be in pairs, and the two paired gravitons spin at the speed of light in the same direction to form a vortex rather than the superstring. 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, and homogeneous three-dimensional space (absolute Newtonian space). In a vacuum, the zero-point energy density is approximately

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

Although quantum theory works out the order of magnitude of the zero-point energy[6] 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 $\boldsymbol{F} = \frac{\mathrm{d}\boldsymbol{p}}{\mathrm{d}t} = \frac{\mathrm{d}(\rho V c)}{\mathrm{d}t}\vec{\boldsymbol{e}} = \frac{\mathrm{d}[\rho(Act)c]}{\mathrm{d}t}\vec{\boldsymbol{e}} = \rho c^2 \boldsymbol{A} = \oiiint \boldsymbol{\nabla} P\,\mathrm{d}V$, fundamental interactions arise from the energy-density gradient of the medium and are transferred 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

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

Since every object is dragging its potential field synchronously at any instant (like 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, we can infer 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 also be understood more intuitively from the perspective of continuum mechanics (note that 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, long-range fundamental forces can be written 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 electrons. Subsequently, the unit of permittivity can be reduced to the time unit, which matches the definition of the flux and is consistent with the fact that the relative permittivity is closely related to the dielectric oscillation frequency. 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

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

Considering $T_0^{\mathrm{vac}} \approx \frac{1}{k_\mathrm{B}}\left(\frac{1}{2}\frac{h}{\varepsilon_0}\right) \approx \frac{1}{2}(\mu_0 ec)c^2$ and that sensing temperature is closely related to 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 $k_\mathrm{B} = 1.380649 \times 10^{-23}\ \mathrm{J}\cdot\mathrm{K}^{-1}$) approximates

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

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 composted of invisible particles (gravitons and virtual electrons) that move at the speed of light ($c^2 = \left(\frac{\mathrm{d}x}{\mathrm{d}t}\right)^2 =$

$\frac{\partial x^2}{\partial t^2}$) . Thus, the waves vibrating in vacuum media satisfy

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

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 essential 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).

Moreover, this article has heralded the end or limits of theoretical physics. It is foreseeable that the development of physics-related disciplines will also be more efficient and significant.

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.

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

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