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The Fundamental Forces and their Unification

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Abstract- This paper introduces the concept of unity, defined as matter or a system with its maximum energy limit. Unity is proposed as the origin of inertia and mass due to its resistance to change. Unity force is defined as matter's tendency of being unity, expressed as attracting while energy sharing in a unity or repelling while excess-energy releasing out of the unity. Mass is a special case of unity force: when in unity, matter's unity force Fu equals its rest mass M: Fu = M. The statement that matter has mass and energy means that matter has a unity force using its energy to maintain its unity. Matter's unity force Fu also equals its weight with its unity centre Wu: Fu = Wu. Unity force is proposed as the fundamental force underlying all known natural forces. Strong force and weak force are the same unity force, with every two protons sharing energy with one electron in atomic nuclei in their respective situations. Electromagnetism results from electron waves releasing excess-energy for dynamic unity that can be aligned and intensified by outside forces. Unity force is also proposed to replace gravity. The paper also challenges certain misconceptions in contemporary physics.

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I. Introduction

In physics, the fundamental forces are interactions in nature that are not currently known to be reducible to more basic interactions. All the known forces of nature can be traced to the fundamental forces.

According to current knowledge, there are four fundamental forces[1]: 1) strong force; 2) weak force; 3) electromagnetism; 4) gravity. Gravity and electromagnetism are long-range forces that can be seen directly in everyday life. Strong force and weak force are subatomic forces that govern nuclear forces inside atoms.

Physicists have been trying hard to unify these four fundamental forces, to find a theory of everything[2], so that a single set of rules can be used to describe the universe. Two theories come close to the goal:

1. General relativity[3] is the geometric theory of gravitation published by Albert Einstein in 1915 and is the current description of gravitation in modern physics, trying to understand the universe on a large scale: planets, stars, and galaxies.
2. Quantum mechanics[4], specifically, the Standard Model[5] of particle physics is the theory describing three non-gravitational forces - electromagnetic, weak, and strong interactions, and classifying all known elementary particles.

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But combining general relativity with quantum mechanics is a major hurdle. Trying to get over the hurdle, two more theories come close:

1. Supersymmetry[2], a complex mathematical framework based on the theory of group transformations, trying to understand the fundamentals of particles, to address internal inconsistencies in the Standard Model of particle physics, and to provide a self-consistent quantum theory unifying all particles and forces in nature.
2. String theory[2], which regards all particles as extended one-dimensional "strings" with preferred patterns of vibration, through which a particle of unique mass and force charge is created. String theory proposes six or seven more dimensions of spacetime on top of the four common dimensions of space and time.

I have a better way, which is to find a "more" fundamental force of all the "fundamental" forces.

II. The Principles of Matter - The Laws of Unity

In the Principles of Matter[6] published in the Global Journal of Science Frontier Research 24(A5), I proposed that matter or a system tends to adjust its energy to a certain level, called the minimum energy requirement. In this updated version, that energy level is called energy limit, and the previously minimum energy formation is renamed unity. Therefore, the Principles of Matter are also called:

The Laws of Unity

1. Concepts and their definitions:
   1) Matter is any substance that has mass and energy. Matter's energy is scalar, not vector, and is always more than absolute zero[6].
   2) Energy limit is the maximum energy limit of matter or a system in its situation.
   3) Excess-energy is the energy that is over the energy limit.
   4) Unity is matter or a system with its energy limit.
   5) Free particles are matter or systems with excess-energy.
   6) Unity centre is the centre of unity. For example, a nucleus is the centre of the atom unity; the sun is the centre of the solar unity (system).
2. *Unity force:* matter's tendency of being unity, expressed as attracting while energy sharing in a unity or repelling while excess-energy releasing out of the unity.

1) Matter attracts other matter to share energy while its energy is below its energy limit (attracting while energy sharing), until being a new unity.
2) A free particle repels other matter while releasing its excess-energy (repelling while excess-energy releasing), until being unity.
3) Breaking a unity requires strong enough initial energy. Then, a new unity begins in the new situation. The more energy is shared in a unity, the more initial energy is required to break the unity.

3. Dynamic unity: matter or a system moves to be unity, expressed as two distinct types of oscillations:
   1) Matter of a unity oscillates around (orbits) the unity centre to share energy, like electrons orbit an atomic nucleus, or planets orbit a star. The orbit is the equilibrium of its unity force.
   2) A free particle oscillates away or about the energy source to release its excess-energy, forming particle waves.
      a. An almost massless particle such as a photon or neutrino oscillates away as light, visible or invisible, depending on its frequency[7].
      b. A larger particle like an electron oscillates away or about the energy source, manifesting as magnetic waves, and in turn oscillates away a photon as light.

Based on the Laws of Unity, I propose:

1. Matter or a system is intrinsically attracting while energy sharing to be a unity. After getting excess-energy from outside forces, matter oscillates away from the unity, becoming a free particle, repelling while excess-energy releasing to be unity again.
2. Matter exists in various states such as gas, liquid, solid, plasma, in different situations; the transition of the state is the process of becoming a unity in each situation.
3. Oscillations of free particles form particle waves (wave-particle duality). Some particles' oscillations are not apparent because their masses are so large that their energy-mass ratios are low[7].
4. As a kind of particle waves, electromagnetic waves are oscillations of free electrons to release excess-energy for dynamic unity, that in turn oscillate away photons as light.
5. Breaking a unity requires strong enough initial energy, and that required initial energy is inertia, which can be measured as mass. That is, unity's resistance to change is the origin of inertia and mass.
6. Scientists are no strangers to unity force: mass is a special case of unity force. When in a unity, matter's unity force Fu equals its rest mass M: Fu = M.
7. The statement that matter has mass and energy means that matter has a unity force using its energy to maintain its unity.
8. People are no strangers to unity force: weight is also a special case of unity force. When in a unity, matter's unity force Fu also equals its weight with its unity centre Wu: Fu = Wu. In our daily life, weight is matter's unity force with Earth, so that all our activities are mostly challenges to unity forces with Earth, like walking, running, jumping, driving, flying, and working.

Unity force will be proved as the fundamental force of all the other natural forces, and the Laws of Unity as the only rules followed by all the other "fundamental" forces.

III. Strong Force

Before 1964, physicists were uncertain as to how the atomic nucleus bonds together. Their knowledge was that the nucleus was composed of protons and neutrons and that protons had positive electric charge, while neutrons were electrically neutral. But positive charges would repel one another, causing the nucleus to break up, which was not the case, which also motivated physicists to seek a deeper understanding of the forces at play within the nucleus.

In 1964, Murray Gell-Mann and George Zweig separately proposed the quark model, leading to the theory of quantum chromodynamics[8], which states that protons and neutrons were composed of elementary particles called "quarks" that carry a "colour" charge; that force-carrier particles called "gluons" transmit the strong force between quarks that carry "colour", where different colour is attracting and same colour is repelling, just like the idea of electric charges.

While quantum chromodynamics is widely accepted, I am looking into the very beginning - the Big Bang, for the origin of the strong force and a deeper perspective.

The Big Bang model[9] describes how the universe began by expanding from a single point of infinite density and heat, known as the singularity, 13.8 billion years ago.

As the universe expanded and cooled, matter formed, as free protons, electrons, photons, and neutrinos (base particles).

Then, each proton shared energy with a neutrino as a proton unity:

$$p + \nu \rightarrow p\nu, \text{ where } p = \text{proton}, \nu = \text{neutrino}.$$

Each electron shared energy with a photon as an electron unity:

$$e + \gamma \rightarrow e\gamma, \text{ where } e = \text{electron}, \gamma = \text{photon}.$$

Proton unities and electron unities are called base unities.

By then, the universe had expanded into many big chunks of matter, one of them was our Milky Way.

And the big chunks of matter had also expanded into many smaller chunks of matter, one of which was our solar system.

In the centre of each chunk of matter, those base unities were so dense and hot, and their energy limits were raised so high, they became attracting and energy sharing. That is, the environment was perfect for matter to share energy, to fuse.

The nuclear fusion in the centre (fusion centre) is mainly through proton-proton chain reaction[10], in which four protons combine to form one helium nucleus, shown as the following simplified steps:

1. Two proton unities and two electron unities share energy to form a hydrogen-2 nucleus called deuterium, releasing a high-energy neutrino (ν^+), a high-energy electron (e^+ or positron) and a high-energy photon (γ^+ or gamma ray):

$$2\,p\nu + 2\,e\gamma \rightarrow {}^2p\nu e\gamma + \nu^+ + e^+ + \gamma^+$$

2. The deuterium ${}^2p\nu e\gamma$ shares energy with another proton unity to form a helium-3 nucleus, releasing another high-energy photon (γ^+ or gamma ray):

$${}^2p\nu e\gamma + p\nu \rightarrow {}^3p^2\nu e + \gamma^+$$

3. Two helium-3 nuclei share energy to form one helium-4 nucleus and release two proton unities to continue the process:

$${}^3p^2\nu e + {}^3p^2\nu e \rightarrow {}^4p^2\nu^2 e + 2\,p\nu$$

4. The helium-4 nucleus, ${}^4p^2\nu^2 e = 2({}^2p\nu e)$, becomes repelling while releasing the excess-energy mentioned above and moves out of the fusion centre to the outer core as the nucleus unity and the product of the fusion.
5. Or the helium-4 nucleus $2({}^2p\nu e)$ shares more energy with other nuclei or proton unities to form an even tighter unity of heavier nucleus: $n({}^2p\nu e)$, where atomic number $n > 2$, if the situation permits.
6. Therefore, in a newly formed nucleus unity from nuclear fusion, every electron shares energy with two protons and one neutrino: $n({}^2p\nu e)$, where the atomic number $n >= 2$. This is how strong force originates and works. No need for quantum chromodynamics[8].
7. A hydrogen nucleus absent from nuclear fusion has only one proton unity ($p\nu$).
8. Most fusion centres release their excess-energy (nuclear decay) through releasing high-energy neutrinos, electrons, and photons:
   1) The high-energy neutrinos (ν^+) and high-energy photons (γ^+) carry their energy away directly.
   2) The high-energy electrons (e^+) transfer their energy to normal electron unities ($e\gamma$) that in turn transfer the energy to their bonded photons (no "annihilation"), producing gamma rays (γ^+):

$$e^+ + e\gamma \rightarrow 2\,e + \gamma^+$$

   The process of high-energy photons (gamma rays) carrying away the excess-energy is called gamma decay.
9. The rest, extra-large fusion centres could not release their excess-energy in the inner core but use it instead for even tighter energy sharing of heavier elements. Without repelling, this leads to black holes with much stronger attraction forces of their respective galaxies.

At this point, the rotation caused by the Big Bang and then intensified by the unity force of the nuclear fusion, made the chunks into disks.

Around 380,000 years after the Big Bang, the position of our solar system in the Milky Way had almost settled. The centre of each disk was still the fusion centre, pulling most of the material toward the centre to form the star, producing the cosmic microwave background radiation and light.

At the edge of each disk, some much smaller fusion centres were also pulling materials toward them that eventually formed the planets, so that most planets had and still have their moons. The products of the nuclear fusions would move to the outer cores and then form mantles and crusts of the planets or flow out through the cracks of the mantles and crusts caused by their nuclear fusions, causing (earth-) quakes and volcanoes.

Out of these fusion centres in the disks, the temperatures were eventually cool enough for the nuclei to capture electrons, forming the first atoms and making the cosmos transparent, bringing the dawn of the universe:

1. Each single proton unity absent from nuclear fusion, attracts and shares energy with an electron unity in the orbit, forming a hydrogen atom: $(p\nu) + (e\gamma)$. This step produces most of the light elements in the current universe.
2. Each of the helium-4 nuclei created in the fusion centres and moved out shares energy with two electron unities in its orbit, forming a helium atom: $2({}^2p\nu e) + 2(e\gamma)$.
3. The heavier nuclei form atom unities the same way, with the same numbers of protons and electrons: $n({}^2p\nu e) + n(e\gamma)$, where atomic number $n > 2$.

So, I propose:

1. The universe is formed of four base particles: proton, electron, photon, and neutrino, produced from the Big Bang. Immediately, a proton and a neutrino form a proton unity; an electron and a photon form an electron unity (base unities). Then the unity force produced more kinds of elements from these base unities.
2. Most fusion centres with excess-energy releasing form stars and planets.
3. The rest, extra-large fusion centres with inner cores unable to release excess-energy as a repelling

force, form black holes with much stronger attraction forces of their respective galaxies.

4. No gravity, nor gravitational collapse, is needed to draw matter (particles) together, because particles were dense and hot in the first place when created. The high density and high temperature were perfect for nuclear fusions.
5. "Positron" here is re-defined as high-energy electron, not the original meaning of "positively charged electron".
6. An atom is formed of the same numbers of protons and electrons sharing energy together: n(^{2}pνe) + n(eγ), n >= 2; the same way as a hydrogen atom: (pν) + (eγ).

IV. Weak Force

Nuclear decay (radioactive decay) is when an unstable atomic nucleus loses energy through emission of high-energy electrons, neutrinos, or photons. Three of the most common types of decay are alpha, beta, and gamma decay.

We already discussed gamma decay as losing very-high-energy photons (γ^+ gamma rays) in nuclear fusion in the last section.

Beta decay happens through the weak force, which is our focus of this section.

As proposed in the last section of Strong Force, nuclei are created in nuclear fusion by every two protons sharing energy with one electron as a nucleus unity n(^{2}pνe), n >= 2, so that one particle shows as proton (p) and the other particle shows as neutron (p + e).

According to the Laws of Unity, breaking a unity requires strong enough initial energy.

In the case of beta decay, the strong enough initial energy mostly comes from random sources of the environment, including high-energy photons (γ^+ gamma rays, X-rays), cosmic rays, high-energy neutrinos or high-energy electrons from other beta decays.

In those unstable nuclei (easily broken unities), the strong enough initial energy cause two types of beta decays:

1. Beta minus decay. Initial random energy breaks free an electron shared with two protons, causing one more proton and one less neutron. That broken-free electron carries the excess-energy away, becoming a high-energy electron (e^+ positron). Then the positron either transfers the excess-energy to a photon (X-ray) or joins another nucleus to create a beta-plus decay and becomes a normal electron again.

   An example of beta-minus decay is the decay of carbon-14 into nitrogen-14 with a half-life of about 5,730 years[11]. In which, carbon-14 (^{6}C) has an electron broken free with high energy, adding one proton and reducing one neutron, becoming nitrogen-14 (^{7}N). The atomic number is increased because only protons are counted in the periodic table.
2. Beta plus decay. That broken-free electron with high energy (e^+ positron) mentioned above can join a nucleus. Since it is high-energy, it can break the original unity, forming a new unity with two protons, causing one less proton and one more neutron, releasing the excess-energy to a neutrino or a photon (X-ray).

   An example of beta-plus decay is the decay of magnesium-23 into sodium-23 with a half-life of about 11.3 seconds[12], in which one high energy electron joins a nucleus of magnesium-23 (^{12}Mg), reducing one proton and adding one neutron, making it into sodium-23 (^{11}Na). The atomic number is decreased because only protons are counted in the periodic table.

So, I propose:

1. Strong force and weak force both originate from nuclear fusion, being the same unity force, with every two protons sharing energy with one electron in nuclei, in their respective situations: strong force happens in the nuclear fusion, weak force happens in the unstable nuclei after nuclear fusion.
2. As proposed before, "positron" here is re-defined as a high-energy electron. When a positron meets a normal electron, energy transfers from the positron to the normal electron; after energy transfer, the positron becomes a normal electron (e).
3. When a normal electron (e) gets energy from a positron,
   1) with very-high energy from a nuclear fusion, the normal electron transfers that very-high energy to its bonded photon and breaks it free as a very-high-energy photon (gamma-ray) in a strong force.
   2) with high energy from a beta decay, the normal electron transfers that high energy to its bonded photon and breaks it free as a high-energy photon (X-ray) in a weak force.
4. Beta decays are evidence that atomic nuclei are composed of every two protons sharing energy with one electron as a unity, except a hydrogen nucleus, which has only one proton and can only share energy with one electron in its orbit. Beta decays are also evidence that quantum chromodynamics is unnecessary.
5. All nuclear decays (not only beta decay) are processes of breaking original unities by initial energy and forming new unities in new situations.

V. Electromagnetism

According to current knowledge, electromagnetism[13] occurs between any two charged particles. Electric forces cause an attraction between particles with opposite charges and repulsion between

particles with the same charge. Magnetism is an interaction that occurs between charged particles in relative motion.

According to the Laws of Unity:

1. Electrons are either attracting in an atom unity or repelling out of the atom unity.
2. Free particles with mass like electrons oscillate away or about the energy source to release excess-energy for dynamic unity, manifesting as magnetic waves:
    1) In most materials, the magnetic waves cancel each other due to random orientations.
    2) In other materials, like iron, many magnetic waves are already aligned in the same direction when created, showing a stronger magnetic field.

So, I propose:

1. Electromagnetism results from free electrons' oscillations to release excess-energy to be dynamic unity, manifesting as magnetic waves that can be aligned and intensified by outside forces.
2. An electrical conductor is: 1) a material, usually a metal, whose outermost electron of any atom can be easily broken free by an electric force, 2) an electrolyte with many free electrons, like battery electrolyte and organic tissues, or 3) a state of plasma filled with free electrons.
3. In an electrical conductor, outside forces can align and intensify the magnetic waves of the free electrons and cause those electrons to flow from high energy to low energy, which is why electromagnetic waves and electric currents happen simultaneously.
    1) Strong magnetic fields align and intensify the magnetic waves of the free electrons, which in turn align and energize the electrons. Outside energy can then cause the electrons to flow from high energy to low energy.
    2) Electric forces align and energize the free electrons, causing them to flow from high energy (voltage) to low energy (voltage), which in turn align and intensify their magnetic waves.
4. These aligned and intensified electromagnetic waves in turn oscillate away the photons bonded with the electrons, causing photon waves (light).
5. The movements of matter (not only electrons) from high energy to low energy are caused by the potential difference, but the fundamental reason is the dynamic unity.

VI. Gravity

In 1666, Isaac Newton famously observed an apple falling from a tree, which inspired him to formulate the law of universal gravitation[14], which states that every particle attracts every other particle in the universe with a force F equal to G (the gravitational constant) multiplied by the product of the masses of the two particles (m_1 and m_2) and divided by the square of the distance R: $F = G(m_1 \times m_2)/R^2$.

So, Newton attributed the cause of gravitation to the masses of particles. But he acknowledged that how the force was propagated was unknown.

Newton's law was later superseded by Albert Einstein's theory of general relativity[3]:

1. General relativity is the geometric theory of gravitation, providing a description of gravity as a geometric property of spacetime.
2. General relativity's spacetime curvature propagates at the speed of light while Newtonian gravity assumes an instantaneous force acting at a distance.
3. General relativity explains gravitational time dilation, frame-dragging, and relativistic effects that Newtonian physics cannot.

According to the Laws of Unity, matter's unity force is replacing gravity. The reasons:

1. Gravity is passive. Unity force is active with two types of actions.
   Gravity is passive. That is why Newton could not find how the gravitational force is propagated, and Einstein had to conjure up the spacetime curvature for gravity to work.
   Unity force is matter's intrinsic tendency of being unity, expressed as actively attracting while energy sharing in a unity or actively repelling while excess-energy releasing out of the unity.

   For example,
    1) In an atom, the electrons and the nucleus attract each other to share energy, but when the outermost electron gets excess-energy, it repels and oscillates out of the atom, travelling with other free electrons as a member of the current, until transferring the excess-energy and becoming attracting again in a new atom.
    2) In fusion centres, protons and electrons are attracting while fusing into helium-4 nuclei (energy sharing). But when those helium-4 nuclei release the excess-energy, they are repelling and moving out of the centres to outer cores. The net force of each fusion centre shows attracting because energy sharing is the primary process.
    3) In a star system, planets oscillate around their star, attracting while energy sharing, until they get too close to their star and becoming energy-excessive, and becoming repelling while excess-energy releasing, leading to their path of respective orbits (equilibria).
2. Between two free particles, there is no attraction, only repulsion, proving that the concept of gravity is a misconception.

In the system of Earth, for example, gravitational attraction is supposed to happen between any two particles, which is not the case. In fact, attraction only happens between a particle and Earth, which is exactly how the unity force works: between a member of the unity and the unity centre. Therefore, in a unity, matter's unity force Fu equals its unity weight Wu: Fu = Wu.

3. Unity is the origin of inertia and mass.
   Both Newton and Einstein have attributed gravity to mass, while mass originates from unity. To be precise, mass is a special case of unity force: when in a unity, matter's unity force Fu equals its rest mass M: Fu = M.
4. Unity force is the fundamental force of all the other natural forces.
   As shown in this paper, the other natural forces are specific aspects of unity force, or unity force in specific situations, and caused by unity force, they all follow the same Laws of Unity, no need for gravity.
   Currently, when considering and studying the other three "fundamental" forces, gravity is already omitted, also proving that the concept of gravity is a misconception.
5. According to the Strong Force section of this paper: No gravity, nor gravitational collapse, is needed to draw matter (particles) together, because particles were dense and hot in the first place when created. The high density and high temperature were perfect for nuclear fusions. And the nuclear fusions, as a unity force, keep pulling matter (particles) towards them.
   According to the formation of our Universe[6] that I proposed in the Global Journal of Science Frontier Research 24(A5): In the star systems, energy sharing, instead of gravitation, is the force to keep the systems the way they are.

VII. Conclusion

1. Unity is matter or a system with its energy limit. Unity is proposed to be the origin of inertia and mass due to its resistance to change.
2. Unity force is matter's tendency of being unity, expressed as attracting while energy sharing in a unity or repelling while excess-energy releasing out of the unity.
3. Scientists are no strangers to unity force: mass is a special case of unity force. When in a unity, matter's unity force Fu equals its rest mass M: Fu = M.
4. The statement that matter has mass and energy means that matter has a unity force using its energy to maintain its unity.
5. People are no strangers to unity force: weight is also a special case of unity force. When in a unity, matter's unity force Fu also equals its weight with its unity centre Wu: Fu = Wu. In our daily life, weight is matter's unity force with Earth, so that all our activities are mostly challenges to unity forces with Earth, like walking, running, jumping, driving, flying, and working.
6. Between two free particles, there is no attraction, only repulsion, proving that the concept of gravity is a misconception. All the other three "fundamental" forces omit gravity, also proving that the concept of gravity is a misconception.
7. Strong force and weak force both originate from nuclear fusion, being the same unity force, with every two protons sharing energy with one electron in nuclei in their respective situations:
   1) The situation of strong force is in nuclear fusion, where very-high-energy neutrinos (ν^+), electrons (e^+ positrons) and photons (γ^+) are released as excess-energy (nuclear decay).
   2) The situation of weak force is in the unstable nuclei after nuclear fusion, where a high-energy electron (e^+ positron) is broken out (beta minus decay) or breaks in (beta plus decay), also with excess-energy releasing (ν^+ or e^+).
8. Electromagnetism results from free electrons' oscillations to release excess-energy for dynamic unity, manifesting as magnetic waves that can be aligned and intensified by outside forces.
9. According to the Principles of Matter, matter's energy is scalar, not vector. Any "antimatter" or "opposite charge" is a misconception, including the concept of "negatively or positively charged" electrons, "oppositely charged" particles, "quantum chromodynamics", and the idea of "annihilation".
10. Unity force is the fundamental force of all the other natural forces, shaping the universe the way it is.

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