# Modern Physics full of mistakes 

The energy circulation theory reconstructs physics

Elementary Energy Circulation

$$
\begin{gathered}
E \psi \\
E=m v^{2}+m \mu_{0}^{2} \omega^{2}=m c^{2} \\
\psi=j v t+\mu_{0}(\cos \omega t+i \sin \omega t) \\
=\mu_{0} \exp (i(k x-\omega t))
\end{gathered}
$$

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## Preface

As opposed to classical ones such as Newtonian mechanics and electromagnetism, which were established by late $19^{\text {th }}$ century, the theory of relativity, quantum mechanics and particle theory, which were proposed one after another from early in the $20^{\text {th }}$ century are called as the modern physics. It is said that they have formed the essence of physics, and along with its progress we have approached the elucidation of the origin of the universe and matter. However, is it true? The problems that remain unsolved are too many and critical. Are the standard models of the cosmic evolution and the particle theory advocated by modern physics really heading in the right direction?

I reported the energy circulation theory in Y2018. This is to firstly throw away the uncertain common senses of existing physics, and consider how the universe evolves and matters are generated from scratch starting from the existence of energy as vibration in multiple dimensions. The Energy Circulation Theory (ECT) presumes the following two assumptions as starting points.

1) Energy can be expressed by $E=E_{0} V^{2}$ as a motion of an intrinsic energy.
2) Between two energy pieces, a force works based on the energy movement (momentum).
It is like a miracle that the ECT gave results that matched measurements one after another for unsolved problems of existing physics.

Following the first publication on the ECT, I reported papers on new particle theory, galactic evolution, quantum mechanics and others derived from the theory. However, it has not yet caught the interest of physicists. An impressive comment of a reviewer was, "To solve the current problems, we need a new theory, but it must base on and incorporate existing physics." He did not point out any inconsistencies or mistakes in the content of the submitted manuscript, but proposed rejection because it did not conform to existing physics. In addition, there were opinions such as "I cannot judge whether this theory is correct, but disagree" and "it is based on an unobserved force". I named the force working on momentums as the "fundamental force". I demonstrated that electric and magnetic forces as well as strong and weak forces are all presentations of the fundamental force. Furthermore, since the

ECT has successfully demonstrated phenomena that cannot be explained by the current physics at all, the force working on momentums (fundamental force) is indeed an observed force. Not only explaining the new world revealed by the ECT, I felt, it is necessary to explain the fundamental contradictions and mistakes of existing physics, which made me take the challenge of authoring this book.

This book deals with the problems of modern physics. While I will also give alternative explanations from the ECT, they will be conceptual and fragmentary with as few mathematical formulas as possible. As for the outline of contents of the ECT, new knowledges about the universe and matter derived from the ECT are explained in the following web site "Capricious walk to physics - energy circulation theory" in a step by step starting from the initial premises. If you have any questions in this book, please visit the relevant part from the link below.

Capricious walk to physics - energy circulation theory http://www3.plala.or.jp/MiTiempo/paseo.html


## Ch.1: Velocity of the Space Expansion and the Light Speed

## 1. Supernova Cosmology Project

In Y1997, Perlmutter et al made a startling interim report, from observations of supernovae, that the expansion of the universe is accelerating. In Y1999, they published the first full paper on measurements of the brightness and redshift from 42 supernovae. This is an international project called the Supernova Cosmology Project (SCP). Since then, data have been accumulated one after another, and the Hubble diagram, which shows the relation of the distance and redshift of stars, has spread to a wide range including the distant universe.

The distance of a star cannot usually be determined by its brightness alone. We cannot judge if a bright star is far away, or a dark star is nearby. The redshift is the lengthening of emitted light wavelength until it reaches the earth due to the space expansion, indicating the time to arrival and the distance traveled. The Hubble diagram is a graph of the distance information obtained from the brightness and that obtained from the redshift, and is linear if handled properly. The distance information becomes a time information if the light speed is given. The redshift $z$ is given by $z+1=n$ if the space distance is expanded by $n$. A redshift is measured by the elongation of wavelengths called absorption lines, which are darken at specific frequencies by absorption by elements. If the redshift of a celestial body is known, the distance is determined, and accordingly its absolute magnitude (brightness) is given from the observed brightness, in general. Note that the redshift here is that for the space expansion. If a light source recedes or approaches, the Doppler effect lengthens or shortens the wavelength. The rotation speed of stars in a disc galaxy is measured by this Doppler effect. But the redshift here means that even if both the emitter and the observer are stationary, the space expansion causes the light to travel a longer distance before it reaches us, and the wavelength of the emitted light also prolongs. The Doppler effect is added to the redshift data of individual celestial bodies, but if the average of many bodies is taken, it is set off and we can ignore it.

A supernova is a massive explosion at the end of stellar nuclear fusion reactions that grows extremely bright for several days and fades rapidly. Type 1a supernovae have nearly constant maximum radiant energy and show the
same maximum absolute magnitude. Therefore, the distance is determined only from the brightness data. In the SCP, the propagated distance obtained from the brightness is divided by the invariant speed of light to obtain the propagation time. The actual measured redshift was smaller than the expected value for the period from the space expansion. Accordingly, they concluded that the rate of the space expansion in the past was smaller than the current one, that is, the space expansion is accelerating.

There is a particularly important caution here: the light speed is treated as have been constant from the dawn of the universe to the present. Has the light speed been constant since the dawn of the universe? If the light speed slows down as the space expands, the light speed at the emission was faster than it is today, and the propagation time obtained from the distance becomes shorter.

As soon as the SCP data were released, their conclusion that the space expansion is accelerating was quickly accepted. It is believed that there is an unknown energy, which exhibits a force to accelerate the space expansion, and is called as dark energy. It has not yet been discovered what dark energy is, despite lots of theoretical investigations and observational efforts. Physicists say, "The existence of dark energy is absolute, supported by observations of the universe," and "It just has not been discovered," or "New theories will find candidates for it." There is no attempt at all to examine the possibility that the interpretation that the space expansion is accelerating may be wrong.

## 2. Anisotropy of the light speed

As mentioned above, the acceleration of the space expansion is under the premise that the light speed is constant regardless of the space expansion. Here, let us review the light speed.

By the middle of the $19^{\text {th }}$ century, the electromagnetism had been established, and led to the realization that the light was an electromagnetic wave propagating with oscillations of electro and magnetic fields. The "light" here includes not only visible lights but electromagnetic waves of all frequencies. The light propagates with vibrations in not only electric and magnetic fields but also in the position where the energy exists in the direction perpendicular to the traveling one. Because the amplitude of a low-frequency
electromagnetic wave is large, even if there is an obstacle on the line of travel, the wave propagates around it. A rotation of the vibration direction in the space indicates a circular polarization. Therefore, we can say that the light is a perfect wave.

If the light is a wave, there must be a medium for it. As a general property of waves, the propagation velocity does not change as the source moves relative to the medium. However, the propagation velocity seen by the observer, who is moving relative to the medium, varies and depends on the direction the light travels. This is called the anisotropy of the light speed. Michelson and Morley tried to measure a change in the anisotropy. The light from the light source was divided into a beam reflected to the vertical direction by a half-mirror and a transmitted straight beam. Both beams were reflected at the same distance, returned to the half-mirror, and were led to the observation device. If the apparatus is moving relative to the medium, there will be a difference in the propagation velocity between the vertical and horizontal beams. The combined beam passes through two slits apart with a very small distance, propagates concentrically from each slit, and forms interference fringes on the screen. They thought that when the whole apparatus was rotated, the speed of motion of the light path relative to the medium would change, and the spacing and position of the interference fringes would change. They conducted this interference experiment, and published the results in Y1881 and Y1887. The later experiment lengthened the light path by reflecting with many mirrors. As a result, no clear change was observed in the spacing of interference fringes, and no change in the position was seen. After that, many people did the similar experiments, but no change was seen. It was then concluded that the light speed is constant regardless of the observer's motion, and further concluded that the light has no medium. This is the famous law of the invariance of the light speed.

There are two very important points to note about these Michelson-Morley-like experiments. One is that the two beams join and go to the detection device, but not one beam through one slit and the other through another one. The combined mixed wave passes through both slits, that is, each beam passes through both slits. The other point is that they are trying to observe the difference in the frequency of the two beams. In modern experiments, instead of observing interference fringes using slits, two beams
are combined and the difference in frequency is measured as the difference frequency (beat note frequency).

## 3. Cautions in measuring the light speed anisotropy by a Michelson interferometer

An apparatus that observes the interference of light beams in two orthogonal directions based on the principle described above is called a Michelson interferometer. A latest one is KAGRA, which observes gravitational waves. The lengths of its light paths in the two arms are adjusted to have a difference of half a wavelength so that when the beams return and combine, they cancel each other out and the amplitude of the mixed wave gets zero, making it nonluminous. When a gravitational wave enters, the lengths of the arms change and the mixed beam emits a light. The luminescence appears as oscillations in a short period of time.

Let us examine the light propagation in a Michelson interferometer. Assume that the two arms are the same length. If the angular frequency of the light is $\omega$, the displacement can be expressed as $y=A \sin \theta=A \sin \omega t$. This angular part $\theta$ is called the phase and has an initial value of zero. When the vibration advances in the direction $x$ with the velocity $v$, the position of the light becomes $x=v t$. A wave in which the vibration propagates in a direction perpendicular to the amplitude is called a plane wave. If we express this plane wave by one formula, it can be described as follows.

$$
y=A \sin \left(\frac{\omega}{v}(x-v t)\right)=A \sin \left(\frac{\omega}{v} x-\omega t\right)=A \sin (k x-\omega t)
$$

This indicates that a position exhibiting a certain displacement moves at $x=$ $v t$, and at a certain position the displacement vibrates with $y=A \sin \omega t . k$ is called the wave number and indicates $k=\omega / v$.

If there is a difference in the light speed between the two split beams that are emitted simultaneously, there will be a time difference $\Delta t$ in the arrival at the junction. Because their mixed wave is measured, the two beams must arrive at the same time. Therefore, the light that takes $\Delta t$ longer is emitted $\Delta t$ earlier. There is hence a phase difference of $\omega \Delta t$ between the two beams at the detector. The displacement of the mixed wave of the two beams is expressed as below.

$$
A_{1}+A_{2}=A \sin (k x-\omega t)+A \sin (k x-\omega(t+\Delta t)), \quad k=\omega / v
$$

The above is by the frame attached to the apparatus. The light speed in the two arms is different, but since both beams are in the same direction from the half-mirror to the detector after they join, the light speed $v$ is the same, and the angular frequency $\omega$ and wavenumber $k$ are also the same for both beams. On the other hand, by the frame stationary to the medium, the propagation velocity is constant regardless of the direction. However, even if the length of the two arms is the same, the length of the optical path to go and return there differs between the two beams. The optical path horizontal to the motion of the apparatus is longer than that perpendicular to it. Therefore, the above equation holds true in the both frames, and $v, \omega, k$ are the same for both beams. In actual experiments, the frame attached to the device is used, so we proceed with the apparatus frame.

Here we devise to express the phase of $A_{1}$ as $0=-\omega \Delta t / 2+\omega \Delta t / 2$ and that of $A_{2}$ as $-\omega \Delta t=-\omega \Delta t / 2-\omega \Delta t / 2$.

$$
A_{1}+A_{2}=A \sin \left(k x-\omega t-\frac{\omega \Delta t}{2}+\frac{\omega \Delta t}{2}\right)+A \sin \left(k x-\omega t-\frac{\omega \Delta t}{2}-\frac{\omega \Delta t}{2}\right)
$$

According to the addition theorem of trigonometric functions, we get the below relation.

$$
\begin{gathered}
\sin (\alpha+\beta)+\sin (\alpha-\beta)=\sin \alpha \cos \beta+\cos \alpha \sin \beta+\sin \alpha \cos \beta-\cos \alpha \sin \beta \\
=2 \sin \alpha \cos \beta
\end{gathered}
$$

The mixed wave above can be transformed as follows.

$$
A_{1}+A_{2}=2 A \cos \frac{\omega \Delta t}{2} \sin \left(k x-\omega t-\frac{\omega \Delta t}{2}\right)
$$

This is the interference wave in the detector after the two beams join. This is a very important formula. When $\Delta t$ changes due to a rotation of the apparatus by such as the rotation of the earth, we obtain the following results.
(1) Even if $\Delta t$ changes due to a rotation of the apparatus, the directions of the both beams are the same, so the light speed $v$, frequency $\omega$, wavenumber $k$ and wavelength are the same between the both beams (invariant in the medium frame).
(2) The amplitude and phase of the mixed wave (interference wave) change with the change of $\Delta t$ due to a rotation of the apparatus.
(1) shows that in Michelson-Morley-like experiments, the spacing and position of interference fringes do not change, and the difference of frequencies of the
two beams is always zero. The phase change in (2) is difficult to measure, but the change in amplitude indicates the change in the brightness of the mixed wave, which is extremely easy to measure. The conclusions can be summarized as follows:

- Up until now, experiments on anisotropy of the light speed tried to detect changes in the frequency (wavelength), so they could not be observed.
- The light speed anisotropy can be found by measuring the change in brightness of the interference wave (mixed wave).


## 4. Method to measure the light speed anisotropy

As mentioned in the conclusion of the previous section, if the light speed anisotropy can be determined by measuring the change in brightness of the interference wave, KAGRA, which is measuring gravitational waves, should be able to measure the anisotropy. KAGRA is currently operating exclusively for the observation of gravitational waves. Since fluctuations due to gravitational waves are very small, the noise removal is performed to reduce vibrations due to other factors as much as possible. One of them is the automatic fine adjustment of the arm length. Regardless of the cause, the beam length is adjusted so that the two beams cancel each other out in the base line and the luminous intensity becomes zero (minimum). When the luminosity increases, it is automatically corrected to zero by adjusting the length. If the time interval of this automatic adjustment is long to some extent, there is no problem in observing gravitational waves with sufficiently shorter cycles. That is, vibrations of a certain frequency or higher are detected, and low-frequency (long period) vibrations are removed as a noise.

If there is a medium for the light, there should be a circadian variation in the brightness of a Michelson interferometer due to the rotation of the earth. If KAGRA's arm adjustment for the noise elimination of long-period vibrations is recorded, a circadian rhythm may be seen in the amount of adjustment. However, it is preferable to change the settings and measure the anisotropy of the light speed. Using much less luminous light than the current one, the length of both beams is set to be the same (the automatic adjustment function is turned off), and the overlap of the two beams becomes brighter in the average. Then the long-cycle fluctuation of the luminous intensity shall be recorded. KAGRA is used exclusively for the main task of observing
gravitational waves, so it should be difficult to use it for the new subject. There is another Michelson interferometer called TAMA300, which was made as a prototype of KAGRA. I wish an anisotropy experiment of the light speed shall be performed using TAMA300. The experiment is not difficult, but the results shall change the world.

In fact, some phenomena suggesting the anisotropy of the light speed have been already mentioned. In the Michelson-Morley experiment, the interference fringes were unstable, and often dimmed or disappeared. They adjusted the mirrors to restore the image, and recorded the fringe spacing. They presumed that it was caused by noise by external factors such as vibration and temperature change. However, the main cause seems to be the change in the brightness due to the change in the phase difference between the two beams. A more direct example is the following. It was presented at a workshop in Italy in Y2008 or Y2010 that circadian variations in the information transfer speed were observed. In the transmission of information between a satellite, Chile and the East Coast of the US, the difference in the transmission speed between the points was observed to fluctuate with a period of one day. The graph of the circadian variation was really beautiful, and I immediately felt that this was exactly the data showing the anisotropy of the light speed. I asked the speaker "isn't it the light speed itself?", but he answered "it is not the light speed but a speed of information transmission". This information transmission is performed by radio waves, and the information transmission speed is equal to the propagation speed of electromagnetic waves (light). Unfortunately, the results have not been published in an academic journal or proceedings.

Why did they call it as information transmission speed? In the world of physics, the light speed invariance is treated as an absolute truth that has been confirmed by experiments over 100 years. The fact that a physicist questions the light speed invariance is said to mean that he/she shall be expelled from the scientific world of physics. When I turned a topic to the measurement principle of the light speed anisotropy, they could not refute my claim, but only said as the light speed invariance has been proven. They did not seem to have thought deeply about the measuring principle, but they just accepted it as an observation result without questioning. Even in the Michelson-Morley's papers, the observation principle was not described in
detail. They described the expectation that the maximum change in the spacing of fringes would be some times of the wave length, but no explanation was given on the grounds for the change in the spacing. After that, physicists concluded that it had been proven that the light speed has no anisotropy, without discussing the measuring principle.

## 5. Lorentz transformation and special relativity

If the light speed is constant regardless of the observer's motion, the additivity of velocities no longer holds. As a means of solving this problem, Lorentz claimed in Y1899 that in a frame moving at a high speed, the length becomes shorter (Lorentz contraction), and proposed the Lorentz transformation that gives a conversion between two frames. He made some corrections, and published the final conversion formulas in Y1904. The progress of time is not the same in all frames, but changes with the relative speed of the two frames. Lorentz himself thought that this transformation was not universal, but was applicable only for electromagnetic waves.

In Y1905, Einstein proposed a coordinate transformation based on the two premises; (1) the light speed is constant regardless of the motion of the light source, and (2) all inertial frames are equivalent (principle of relativity). The result was exactly the same as the Lorentz transformation. He himself said that he had not known the Lorentz transformation. This is the special theory of relativity, which is applicable to all motions of anything not only for electromagnetic waves. Combining (1) and (2), the premises mean that the light speed is invariant not only for the motion of the light source but also for the motion of the observer. In short, it claims that the Lorentz transformation is needed instead of the Galilean transformation. A growing number of physicists are now questioning whether the general relativity on the gravity needs to be changed or there is another theory of the gravity. However, almost all of them believe that the special relativity is right, and that any theories must satisfy the Lorentz invariance.

## 6. Light speed and the Hubble diagram from the SCP

As mentioned so far, the light speed invariance has not been confirmed experimentally. On the contrary, phenomena suggesting the anisotropy of the light speed have been observed. There is no room for questioning the
nature of the light as a wave. Before proposing the energy circulation theory, I proposed a cosmological model, in which an energy vibration gives an additional energy, and an energy we observe is a vibration of the energy that works as the medium. The vacuum space of the universe is filled with this medium, which I named as the space energy. The light is also a vibration of the space energy.

The propagation velocity of a wave in general is proportional to the square root of the density of the medium. For the sound wave, the medium is air in the air and water in the water. Therefore, the sound propagates faster in the water than in the air. In a vacuum there is no medium and the sound cannot propagate. The medium for the light is the space energy composing the vacuum space. The light transmits slower in the air or water than in the vacuum, this is because it interacts with charged particles and scatters, and travels in zigzag, which slows the apparent speed of the light. I named it as the electromagnetic interaction factor. The density of the space energy decreases as the space expands. I named it as the energy density factor. For a while after the drawn of the universe, the light could not travel straight due to the electromagnetic interaction factor, and its apparent velocity was zero. When protons and electrons formed hydrogen atoms, the space immediately cleared up for the light. Then the light speed got to be essentially determined only by the energy density factor.

Let $x$ be the radius of the universe, then the light speed in the vacuum is inversely proportional to the square root of $x^{3}$.

$$
c(x) \equiv \frac{d L}{d t}=\frac{K_{1}}{\sqrt{x^{3}}}
$$

The radius of the universe can be taken also as an index of time. The propagation distance per the increase $d x$ is newly defined as the light speed per the radius $C(x)$. Since this radius $x$ is the space expansion itself, it can easily express the redshift. Therefore, the Hubble diagram showing the light propagated distance and the redshift can be easily obtained using this $C(x)$. As a unit of the radial distance, let $x=1$ be the maximum value at which the space expansion stops in the future, then the light speed $C(x)$ is expressed by the following formula.

$$
C(x) \equiv \frac{d L}{d x}=c(x) \frac{d t}{d x}=\frac{K}{x \sqrt{1-x}}
$$

Let $x_{P}$ be the present radius and $x_{E}$ be that at the emission, then the redshift is as follows.

$$
z=n-1=\frac{x_{P}}{x_{E}}-1
$$

By the same data processing as that used for the published Hubble diagrams of supernovae, I obtained the Hubble diagrams from the above theoretical model, and compared them with the measured ones. The result revealed that the line for $x_{P}=0.7$, that is, the present cosmic radius is 0.7 of the maximum radius, showed an excellent fit to the observed Hubble diagram. The results were published in Y2017 in the proceedings of a workshop.

Thus, once we accept that the light has a medium, the supernova data do not show an acceleration of the space expansion, so there is no dark energy to cause the acceleration. The space is filled with the space energy which acts as a medium. The space expansion is slowing down by the usual time (called the original time), and is constant by the cosmic radius as a time (called the Observed Time).

Details about the space energy, light speed, redshift, and Hubble diagram are described in \#44-\#51 of Capricious walk to physics, which is introduced on the page 3 of this book. In \#51 particularly, the overlay of the measured Hubble diagram and the theoretical graph from this model is shown, so please refer to it.

## Ch.2: Energy Circulation Theory

## 7. What is the energy

As mentioned in the previous section, the Hubble diagram from the observed data of supernovae does not prove the existence of unknown dark energy, but shows the observational evidence that the light has a medium and that the light speed has slowed down due to the space expansion. Here, the task is what is the medium? and by what kind of vibration does the energy propagate?

The first one of the two premises of the energy circulation theory (ECT); energy can be expressed as a motion of an intrinsic energy, was proposed before the ECT, and led to publications of the formula of the light speed and the Hubble diagram for the space expansion, as mentioned in the former section. As a start for thinking about the universe, I assumed that the space is the region where energy exists, that the term "existence" means there exists an energy, and that an energy is a vibration in multiple dimensions. In this way of thinking, everything that exists is an energy, and there is no existence that does not come down to energy. The energy is defined first, then its distribution, motion, and interactions give other physical properties. This is contrary to the current general way of thinking. In existing physics, there are properties like the mass and the electric charge, from which an energy is defined secondarily. However, neither the mass nor the electric charge is defined.

In the ECT, the energy is defined as "what exists in the universe". It claims that the motion of an energy vests an additional energy, and the total energy is expressed by the following formula.

$$
E=E_{0} v^{2}
$$

A motion of an intrinsic energy $E_{0}$ at a speed $v$ shows the total energy $E$. The quantity of the intrinsic energy can be defined as the mass in a broad sense. There are plural ways to take an intrinsic energy for the same energy, depending on the direction of a motion. Depending on its choice, the speed differs, but the total energy is the same.

$$
E=M_{1} V_{1}^{2}=M_{2} V_{2}^{2}=m c^{2}
$$

The intrinsic energy $m$ moving at the light speed $c$ is especially defined as the "mass" in the narrow sense. Now onward, we call an intrinsic energy moving at the light speed as a mass and that at other speed as an intrinsic energy.

The above equation along with the force working on momentums to be explained next are the premises to start for the ECT. The two premises are the very essence of the ECT, and they jointly with new physical consequences derived from them are called as the ECT. If the physics developed under the premises can describe the observed facts correctly, the premises will be appraised as correct. For this reason, I call the premises as a theory.

## 8. Force working between energies

The mystery of the Hubble diagram of supernovae has been solved, but the question remains what the medium is and how it vibrates. At first, from the space energy, which acts as the medium, we distinguish the energy, which we can observe and is derived from its vibration, and call it as the apparent energy. The equation between the total energy and the intrinsic energy, which was shown in the former section, holds true for an apparent energy as well. In the case of light, the intrinsic energy goes straight, but in a particle, it is in a steady state. It is proper to guess that the intrinsic energy is circulating in a particle. When the intrinsic energy $m_{0}$ circulates at the light speed $c$, it becomes a stationary particle with the energy $E=m_{0} c^{2}$, in which $m_{0}$ is the rest mass. However, here comes out a big question; what is the force that bends the motion of the intrinsic energy to circulate? The entire cosmic energy can be regarded as an energy circulation with an expanding radius, but the force controlling it was unknown. I thought at first that the expansion was slowing down due to the gravity, but I got to realize that the gravitational force is too weak. I examined if the force giving the internal circulation of a particle might be the electromagnetic force, but it could not explain particles without an electric polarization. I speculated various possibilities such as a local polarization in the medium with keeping neutral in a large range, but could not find a solution at all.

At one point, I came up with the idea that there might be a force working on the movement of energy. It was a bolt from the blue, and I instantly felt that we could solve all the puzzles. The second premise was added, and here the energy circulation theory was born. In contrast to that the gravitational
force works based on the amount of energy, we suppose that there is another universal force, which works based on the energy movement, namely the momentum. I named it as the "fundamental force". The current physics claims there are four fundamental forces. However, the electromagnetic, strong and weak forces of them except for the gravity are presentations of the fundamental force in fact.

We define the term "momentum" as $\mathbf{p}=M \mathbf{V}$ by the intrinsic energy and the velocity. The momentum has a direction, same as that of the velocity, in addition to its amount, so it is a vector. Therefore, the fundamental force embraces an angular factor in addition to a distance one. In the case of two momentums in the same plane, I proposed that the following force works between them, which is inversely proportional to the square of the distance.

$$
F=K_{f} \frac{{ }_{\mathbf{r}} \mathbf{p}_{\mathbf{1}} \cdot{ }_{\mathrm{r}} \mathbf{p}_{2}}{d^{2}}=K_{f} \frac{p_{1} p_{2}}{d^{2}} \sin \theta_{1} \sin \theta_{2}
$$

The angle $\theta$ is that of a momentum to the distance direction, and $\left|{ }_{\mathbf{r}} \mathbf{p}\right|=p \sin \theta$ is the vertical component of the momentum to it. If the two components are in the same direction, the force is positive and repulsive. If they are in the opposite directions, the force is negative and attractive. The general formula of the force including the case, where the motions of two energies are not on a single plane, becomes as shown in the figure below with the addition of another angular factor.


$$
F=K_{f} \frac{{ }_{\mathbf{r}} \mathbf{p}_{\mathbf{1}} \cdot{ }_{\mathbf{r}} \mathbf{p}_{2}}{d^{2}}=K_{f} \frac{p_{1} p_{2}}{d^{2}} \cos \theta_{p} \sin \theta_{1} \sin \theta_{2}
$$

$K_{f}:$ Fundamental force constant

The velocity alters depending on what an intrinsic energy is taken, and the momentum also varies. However, the force is the same. Therefore, the fundamental force constant $K_{f}$ depends on the velocity of intrinsic energies. If we choose intrinsic energies that show a common velocity, the fundamental force constant becomes in constant. According to circumstances, we can take a convenient intrinsic energy, but that with the current light speed $c$ is especially called as the mass in the narrow sense.

## 9. Intra-circulation force and force between energy circulations

Antiparallel motions of two energy pieces will bend and make a circle due to the attraction by the fundamental force if conditions are met. We call this attractive force as the "intra-circulation force". I named the following one as the "energy circulation"; a circle, which consists of a continuous intrinsic energy, and shows the radius depending on its energy amount by the balance of the intra-circulation force with the centrifugal force.

Between two energy circulations there works a force by the fundamental force. We call the interaction in the same plane as the "flat interaction" and that of overlapped two circulations in the axial direction as the "orthogonal interaction". When two retrorse circulations overlap, the orthogonal interaction is attractive, and a coupled conjugate pair is formed. When the conjugate pair separate horizontally, an attractive force acts up to the adjacent position to urge them to return, and a repulsive force works from there on to accelerate the separation. When two circulations of the same direction separate in one plane, they try to adjoin by their flat interaction. The force is repulsive up to the adjacent point and attractive at a larger distance.


## 10. Cosmic separation to two universes

We assume that the initial energy is a multi( $M$ )-dimensional vibration consisting of $\mathrm{M} / 2$ pairs of coupled conjugate circulations in a 2-D plane. This separates in one dimension into two universes. At this time, the angular frequencies of two pairs of coupled conjugate circulations are divided into $+\omega$ and $-\omega$ resulting in a single circulation in each universe. Their balances with the centrifugal force collapse, and their radiuses expand. In two 2-D circulations, in total in four dimensions, the energy distribution expanded. In the remaining M-4 dimensions, the intrinsic energy of each coupled pair was divided into two, but kept as a conjugate pair (double circulation) in each universe. The radius of those circulations was once reduced due to the separation, but has been kept as constant after that. The momentum of a double circulation is cancelled out by retrorse circulations to be zero. Therefore, a double circulation does not affect an inter-circulation force with
other circulations. On the other hand, the radiuses of two single circulations expand in the 4-D space. Let $X_{1}, X_{2}, X_{3}, X_{4}$ be the 4-D cartesian coordinates and $r$ be the radius, then the two circulations can be expressed as below.

$$
\left[\begin{array}{ll}
X_{1} & X_{2}
\end{array}\right]=r\left[\begin{array}{ll}
\cos \omega t & \sin \omega t
\end{array}\right], \quad\left[\begin{array}{ll}
X_{3} & X_{4}
\end{array}\right]=r\left[\begin{array}{ll}
\cos \omega t & \sin \omega t
\end{array}\right]
$$

Expressing this by 4-D polar coordinates, the energy distribution is shown by

$$
\mathbf{X}=\left[\begin{array}{lll}
r & \theta_{1} & \theta_{2}
\end{array} \theta_{3}\right]=\left[\begin{array}{llll}
r & \omega t & \theta_{2} & \omega t
\end{array}\right] .
$$

$\theta_{2}$ continuously spreads in $0 \leq \theta_{2} \leq \pi$, and is an angular index to show a position. As we can see here, the cosmic energy is distributed in the 3-D surface of a 4-D sphere. This 3-D surface is generally called a 3-D spherical surface or simply as 3-D sphere, but we call it as 3-D surface to avoid a confusion with a 4-D sphere (ball).

Quite some time ago, there were some cosmic models, in which one dimension was added and the universe was distributed on the surface in the 4-D space to give an edge-less and evenly spread 3-D space. The Poincare conjecture is one of the difficult mathematical problems, and Perelman succeeded in proving it in Y2002, which caught a big sensation. It claims that we make a loop with something like a string in anywhere in the 3-D space and if it narrows to one point at end when the string is pulled, this 3-D space must be a 3-D spherical surface in the 4-D space. This shows that a 3-D space with no edge and no hole must be a 3-D surface of a 4-D sphere. Observations revealed that the universe is spread uniformly without an edge or hole, so the space of the universe is required mathematically to be a 3-D surface of a 4-D sphere.

## 11. Space energy and its unit structure; spacia

Circulations in the rest dimensions other than the 4-D space remain as a double circulation, that is, keep symmetry and act as an intrinsic energy for a motion in the 4-D space. On the other hand, the first circulations in the 4-D space are a single circulation and asymmetric. We divide the cosmic energy into the symmetric part called as the space energy and the asymmetric part called as the apparent energy. We express the circulation in the $X_{1}-X_{2}$ plane described in the former section by the radius $r$ and the arc distance $v t=r \omega t$ on the circumference. Let $\mathbf{e}_{\mathbf{0}}$ be the unit vector for the radius and $\mathbf{e}_{\mathbf{1}}$ be that for the arc, then the circulation is expressed as below.

$$
\left[\begin{array}{ll}
X_{1} & X_{2}
\end{array}\right]=r\left[\begin{array}{ll}
\cos \omega t & \sin \omega t
\end{array}\right]=r \mathbf{e}_{\mathbf{0}}+r \omega t \mathbf{e}_{\mathbf{1}}
$$

The energy resides in the spherical surface of the 4-D sphere, so it is in the very thin thickness in the radial direction although the radius is increasing. This thickness is the diameter of circulations in the rest dimensions, and is constant since the rest dimensions are not expanding. Let $\mu_{0}$ be the radius of the rest dimensions. This value is an important fundamental constant in the ECT, which is invariant as the space expands.

The arc direction $\mathbf{e}_{\mathbf{1}}$ forms a 3-D Cartesian coordinate system with the remaining $X_{3}$ and $X_{4}$. The $\mathbf{e}_{1}$ direction is a straight line in the 3-D space, but is a circle with $\mathbf{e}_{\mathbf{0}}$ in the 4-D space. Since the space energy exists uniformly in the space, we take a 4-D sphere with the radius $\mu_{0}$ as a unit area of the space. We define the space energy in this unit area as the "spacia". The diameter $2 \mu_{0}$ is the thickness of the space of the universe in $\mathbf{e}_{\mathbf{0}}$. We call the direction $\mathbf{e}_{0}$ as the "hidden dimension", expressed as $H$. There are a huge number of spacias in the three space dimensions, and the number is increasing with the expansion. However, in the hidden dimension H, spacias exist only in one layer. The energy distribution of the spacia, which is a unit one of the space energy, can be expressed as a coupled conjugate pair of circulations (double circulation) in the hidden dimension H and the space dimension X by the following equation. The unit vector in H is shown by $i$. Although the imaginary unit is used, it does not mean that the part does not exist, but means that it is in an orthogonal direction to the real number part.

$$
\text { Spacia: } \begin{gathered}
E_{\mu}\left[\begin{array}{ll}
X & H
\end{array}\right]=E_{\mu} \mu_{0}\left(\cos \omega_{0} t+i \sin \omega_{0} t+\cos \left(-\omega_{0} t\right)+i \sin \left(-\omega_{0} t\right)\right) \\
\equiv E_{\mu} \mu_{0}\left(\varphi_{0}+\varphi_{0}^{*}\right)
\end{gathered}
$$

The coupled conjugate circulations do not join completely, but keep a small distance between them. Further, the space dimension X may be any direction in the 3-D space, and the direction may change over time.

Here we use the following notation: When an energy $E$ shows a distribution shown by $\psi$, we express the fact by $E \psi$. The energy distribution of the spacia, which is mentioned above, consists of two retrorse circulations as shown by $\psi_{\mu}=\mu_{0} \varphi_{0}+\mu_{0} \varphi_{0}^{*}$. As for an energy circulation in general, when it moves in a linear direction, the intrinsic energy shows a helical motion, the distribution function $\psi$ of which includes a linear component as well as a
circular one. This function is a wave function to show a circulation (vibration) and its propagation. Another important point is that the positions of the total energy, the intrinsic energy and the momentum are all the same. So, the wave function shows the position / distribution of not only the total energy but all so those by $E \psi, m \psi, p \psi$ etc. $\psi$ is common for all of them.

The velocity of the internal circulation of the spacia is $v_{c}=\mu_{0} \omega_{0}$. It is the phase propagation velocity as a medium, and equal to the light speed.

$$
v_{c}=\mu_{0} \omega_{0}=c
$$

The radius $\mu_{0}$ of the spacia is an invariant, but the frequency $\omega_{0}$ is a function of the cosmic radius $x$. As the space expands, the number of spacias increases in proportion to $x^{3}$, and the energy of a spacia, which is the density of the space energy, decreases in inverse proportion to $x^{3} . \omega_{0}$ and the light speed are inversely proportional to $\sqrt{x^{3}}$, and the formula expressing the light speed is exactly the same form as

$$
c(x)=\frac{K_{1}}{\sqrt{x^{3}}}
$$

, which was obtained from the density change of a medium in the page 12. Here, the origin of the light speed and the reason why the light speed decreases with the space expansion have been clarified.

## 12. Evolution of the apparent energy

As the space expands, the space energy consisting of spacias keeps the symmetry by a decrease in the circulating velocity and an increase in the number of the spacia. On the other hand, the asymmetric motions of the apparent energy expand and separate in the space dimensions.

An apparent energy is given as a form of an additive circulation to one circulation in a spacia, and is transmitted on the successive spacias. The distribution showing the circulation of the cosmic energy, which is shown in the sections 10 and 11 , is applied to the apparent energy as it is. We described there the expression of the circulation in the $X_{1}-X_{2}$ plane by the unit vectors; $\mathbf{e}_{\mathbf{0}}$ for the radial and $\mathbf{e}_{\mathbf{1}}$ for the arc directions. Let $j$ and $k$ be the unit vectors of $X_{3}$ and $X_{4}$, then the distribution of the apparent energy just after the cosmic separation is expressed by the 3-D Cartesian coordinates as follows. It seems a complicated formula, but has been obtained by conversion
from 4-D polar coordinates to 4-D Cartesian first and then to 3-D Cartesian coordinates including $\mathbf{e}_{\mathbf{1}}$. Please see it just as the obtained result. The hidden dimension H is not included, but the motion there is reflected in the intrinsic energy.

$$
\mathbf{x}=\mu_{0} \omega t \mathbf{e}_{1} \cos \theta_{2}+\mu_{0} \sin \theta_{2}(j \cos \omega t+k \sin \omega t), \quad\left(0 \leq \theta_{2} \leq \pi\right)
$$

It shows that an energy is circulating in the $j-k$ plane and linearly moving in the $\mathbf{e}_{\mathbf{1}}$ direction. The radius of the circulation is $r=\mu_{0} \sin \theta_{2}$, continuously filled from 0 to $\mu_{0}$ with a disc-like shape. The velocity of the linear motion is $v=$ $\mu_{0} \omega \cos \theta_{2}$, which is the fastest at the center and zero at the maximum radius. The following figure shows the initial changes of the apparent energy.


Separations and cyclic decomposition of the initial apparent energy
(a) is the status just after the cosmic separation. The both ends in the $\mathbf{e}_{\mathbf{1}}$ direction are connected as a circle with $\mathbf{e}_{\mathbf{0}}$. By the space expansion, it immediately separates to plural discs (b), each of which further divides into plural circulations with different values of the radius and the linear velocity as shown in (c). The linear velocity has the right or left direction depending on the value of $\theta_{2}$. These energy circulations are a single circulation in spacespace dimensions. Then, each circulation becomes unable to keep as a continuous circulation, and decomposes to numerous local circulations orthogonal to the main one as shown in (d). We call it as the cyclic decomposition. A parent circulation is a collection of its daughter circulations. The cyclic decomposition is a simultaneous decomposition into daughter circulations. The rapid space expansion causes the cyclic decomposition repeatedly over plural generations, and energy circulations with smaller radiuses and energies are generated.

Several generations of cyclic decompositions form the structure of the universe, where a myriad of space-space dimensional single-circulations are
constellated in the vast 3-D space. The motion of the first circulation remains as the largest-scale motion of the entire universe, and later circulations remain as motions of superclusters and then as those of galaxy clusters. Once the energy of an energy circulation has decreased to a certain minimum, the cyclic decomposition gets no longer capable to occur in it. We call this level of circulations as the galactic seed. After that, the galactic seed separation to two seeds starts instead of a cyclic decomposition. In the process of a galactic seed separation, the potential energy decreases and emits radiations; the gamma-ray burst and the gravitational wave. The name "gravitational wave" seems inappropriate, but we use it to match the general name. It is a wave, in which a space-space dimensional circulation is transmitting in a space direction. The light including the gamma-ray is a wave, in which a hiddenspace dimensional circulation is transmitting in the space.

After the galactic seed separation is repeated several times, the energy of a seed is decreased, and the seed no longer can separate to two ones. Then, the stellar seed separation from a galactic seed starts and forms a galaxy. A stellar seed releases daughter circulations, which decompose to those of lower levels in some rounds. In the end, they decompose to the smallest energy circulation with the same radius as that of the spacia. We call an energy circulation, which is quantized in one plane of a spacia, as the elementary circulation. There are two types of an elementary single circulation; one is in hidden-space dimensions shown by iS, and the other is in space-space dimensions shown by $S$. The distribution and amount of the energy are shown as below.

$$
\begin{gathered}
E_{(i s)}\left[\begin{array}{ll}
X & H
\end{array}\right]=E_{(i s)} \mu_{0}\left(\cos \omega_{0} t+i \sin \omega_{0} t\right) \\
E_{(S)}\left[\begin{array}{ll}
X & Y
\end{array}\right]=E_{(S)} \mu_{0}\left(\cos \omega_{0} t+i \sin \omega_{0} t\right) \\
E_{(i s)}=E_{(S)}=m_{0} \mu_{0}{ }^{2} \omega_{0}{ }^{2}=m_{0} c^{2}
\end{gathered}
$$

$\mu_{0}$, which is the radius of the spacia, is an invariant. $m_{0}$ is also an invariant by the space expansion, and is the same as the intrinsic energy of one of two conjugate circulations of the spacia. This is because an apparent energy is given by an addition of the internal circulation of the spacia. As the space expands, $\omega_{0}$ gets smaller and the energy of an elementary circulation decreases. From the elementary single circulations iS and $S$, the double circulations $i D$ and $D$ are generated. Their excited forms $i D^{\#}$ and $D^{\#}$, the
circulating velocity of which are doubled, are also produced. A composition of these elementary circulations on plural 2-D planes in a spacia forms a meson or a baryon like proton and neutron. We call such a composition of energy circulations in a spacia as the "quantum particle".

## 13. Momentum in the hidden dimension and the electric charge

Since there is only one layer of spacias in the hidden dimension H , the energy cannot stretch in H . In order to be stationary in the space energy, it is required to be quantized as is as explained in the former section. By absorbing light, iS prolongs over plural spacias in a space dimensional direction. This energy increase is a gain in the electric potential energy due to the prolongation in a space dimension. The momentum in the hidden dimension H is constant and does not change even if iS prolongs.

The hidden dimension is orthogonal to any direction in the 3-D space. Further, the momentum in the hidden dimension is only in one dimension. Therefore, while the charge for the fundamental force is a vector, two momentums in the hidden dimension with any space distance can be treated as a scalar since they have no direction in the 3-D space. However, it is a plus or minus charge depending on the direction in $H$. This momentum in the hidden dimension is the essence of the electric charge. The electric charges of the quantized circulation $i S$ are $+e$ and $-e$, the amount of which is the elementary charge. In a prolonged $i S$, the two electric charges are spread to plural spacias but no change in the total values. I will introduce the electric charge and force, as well as the prolongation of $i S$ in detail on the page 38 of this book. For more details, please refer to \#15 and \#16 of Capricious walk to physics. On the other hand, a momentum in space dimensions of a hiddenspace circulation is the magnetic charge, which is a vector charge in the 3-D space.

## Ch.3: Problems of Quantum Mechanics

## 14. Energy quantum

Around the end of the $19^{\text {th }}$ century, the problem of the black-body radiation attracted a big attention. What answered to it was the energy quantum hypothesis by Planck. Electromagnetic waves, which are emitted from a heated object, are called as a thermal radiation. Their frequencies are distributed over a wide range, and the spectral intensities show a distribution curve specific to the temperature. The higher the temperature is, the greater the intensity is and the higher the frequency of the maximum intensity is. A black body is a virtual object that absorbs all electromagnetic waves from the outside. If there is a small viewing window in a closed blast furnace, the external light that enters through the window will be reflected in a complicated manner inside and will hardly come out of the window again, so it can be regarded as a black body. Therefore, the radiation from the small window is a black-body radiation and reflects the temperature of the contents.

Wien proposed the Wien's formula to express the spectral distribution as a rule of thumb from experimental data. This formula agreed with the experimental data only on the high frequency side but not at all on the low frequency side. In Y1900, Rayleigh derived the intensity of the spectrum from classical mechanics and thermodynamics, and Jeans corrected it in Y1905, which is the Rayleigh-Jeans formula. This formula agreed well with the measured data on the low frequency side but did not reflect the high frequency side.

In Y1900, Planck mathematically connected the Wien's formula and the Rayleigh-Jeans one, and proposed the Planck's radiation formula. This formula agreed with measured data in the whole range but there was no theory to explain it. Then, in Y1900 Planck proposed the hypothesis that the energy of electromagnetic waves has a minimum unit, which he called as the energy quantum. The Planck's radiation formula was successfully derived from the theory of the energy quantum (which is difficult for me to understand). He claimed that the light has a minimum energy for each frequency, and can take only discrete values that are integer multiples of it. Taking only discrete levels of energy in this way is called as the quantization of energy.

$$
\begin{gathered}
E_{n}=n h v, \quad n=0,1,2, \cdots \\
E_{q}=h v=\hbar \omega, \quad(\omega=2 \pi v, \hbar=h / 2 \pi)
\end{gathered}
$$

The energy quantum is proportional to the frequency, ant the proportionality constant is the Planck constant. Using the angular frequency $\omega$, the constant is $\hbar$ ( h -bar).

This formula is for the energy quantum but is not the energy of the light. A light beam is detected by a device, and the energy per unit time (second) is defined as the energy of the light. An energy quantum is one cycle of light, the product of which by the frequency $v$ is the minimum unit of the light.

$$
E_{\gamma}=v E_{q}=h \nu^{2}
$$

This formula is rarely referred to as the energy of the light, and is often confused with the energy of the energy quantum. However, in actual astronomical observations, results are adjusted by a value of the wavelength when they are compared with data observed by a different wavelength. I mention again, the energy quantum of light is the energy per cycle.

While I skip the explanation here, based on the energy circulation theory, I explained how a light is emitted, and showed that the energy of a unit beam is as follows.

$$
E_{\gamma}=2 \pi^{2} m_{0} \mu_{0}^{2} v^{2}=h v^{2}, \quad h=2 \pi^{2} m_{0} \mu_{0}^{2}
$$

The Planck constant $h$ is an invariant that does not change with the space expansion, but is a secondary one derived from the basic constants $m_{0}$ and $\mu_{0}$ of the ECT. Please refer to \#18 of Capricious walk to physics.

## 15. de Broglie wave hypothesis

At the end of the $19^{\text {th }}$ century, the photoelectric effect, which shows the following characters, was known. When a light beam of a certain frequency or higher is irradiated to a metal, electrons are ejected. The kinetic energy of those electrons depends on the frequency of the irradiated light, but that per each electron does not change even if the light intensity is increased. In Y1905, Einstein explained the photoelectric effect by the light quantum theory. From the Planck's light quantum hypothesis and the characters of the photoelectric effect, many people came to think that the light also has properties of a particle. This is called as the wave-particle duality of the light. A light quantum came to be called as a photon because of its particle nature.

By the way, the standard physics still does not define the term "particle". They regard that the particle has a rest mass and the rest mass of an energy radiation is zero. In the ECT, everything is a wave, in which an intrinsic energy is in motion, and what it forms a continuous energy circulation is the particle. An interaction is generated between two particles by the fundamental force.

In Y1924, de Broglie proposed the hypothesis that all particles, not just the light, have the wave-particle duality. He claimed that the de Broglie wave, later called as the matter wave, accompanies a particle. The wave has the relation $E=p v, E=\hbar \omega$ and fulfills $p=\hbar k$ like the light, he claimed. On the other hand, the kinetic energy of a particle is $E=p v / 2$, and does not meet this condition.

> Matter wave: $E=p v, E=\hbar \omega \Rightarrow p=\hbar k$
> Kinetic energy: $E=m v^{2} / 2=p v / 2$

De Broglie regarded this wave as a wave associated with a particle, but never said that it corresponds to the kinetic energy.

## 16. Formularization of quantum mechanics: Schrödinger equation

The de Broglie hypothesis had a great impact, and the focus was on what the accompanying matter wave was in concrete and how it could be expressed. Heisenberg was the first to derive an equation for wavefunctions that satisfy the condition $p=\hbar k$ of the de Broglie hypothesis, and published it as a matrix equation in Y1925. Schrödinger reported that in a wave equation in Y1926. The two were then proved to be mathematically equivalent, and give wave functions as a solution. Let us see the derivation of the Schrödinger equation.

He had a wave function of a usual plane wave in mind first, and sought an equation to give it as a solution. In the ECT, as already mentioned, an energy distribution can be expressed as a wave function. The energy distribution of the single circulation in space-space dimensions $S$ in static is expressed by

$$
\psi_{0}=\mu_{0}\left(\cos \omega_{0} t+i \sin \omega_{0} t\right) .
$$

$\mu_{0}$ is the radius of the spacia and the smallest one for energy circulations. No one can decompose to a circulation of a smaller radius than it. Here the imaginary unit $i$ is used, but it is simply the unit vector of a direction
orthogonal to that shown as a real number. In the case of $S, i$ is also a space direction in the 3-D real space. As already mentioned, the energy is shown as below.

$$
E_{(S)}=m_{0} \mu_{0}{ }^{2} \omega_{0}{ }^{2}=m_{0} c^{2}
$$

When the energy $\Delta E$ is added to it and it moves at the speed $v$, the intrinsic energy shows a helical motion as shown below, but its velocity is unchanged as $c$ and the intrinsic energy (mass) increases.

$$
m_{0} c^{2}+\Delta E=m c^{2}=m\left(\mu_{0}^{2} \omega^{2}+v^{2}\right)=m\left(C_{r}^{2}+v^{2}\right)
$$

$C_{r}=\mu_{0} \omega$ is the circular component and $v$ is the linear component of the velocity of the helical motion. The energy distribution can be expressed by a wave function as follows.

$$
\psi=j v t+\mu_{0}(\cos \omega t+i \sin \omega t)
$$

The other imaginary unit $j$ is the unit vector for the direction of the linear motion, and the all three directions, orthogonal to each other, are in the 3-D real space in this case. The above formula is a 3-D expression of a wave function. We can express the same wave function by two 2-D plane waves orthogonal to each other.

$$
\begin{gathered}
\psi(x, t)=\psi_{1}+\psi_{2}=\mu_{0} \cos \left(\frac{\omega}{v}(x-v t)\right)+i \mu_{0} \sin \left(\frac{\omega}{v}(x-v t)\right) \\
=\mu_{0} \cos (k x-\omega t)+i \mu_{0} \sin (k x-\omega t)
\end{gathered}
$$

The wave function in this form is the same form with only difference in the amplitude as what Schrödinger expected as a solution.

The wave function Schrödinger had in mind is

$$
\psi(x, t)=A(\cos (k x-\omega t)+i \sin (k x-\omega t)) .
$$

He converts it to be expressed by a momentum $p$ and an energy $E$. Here he used the relations $E=\hbar \omega$ and $p=E / v$ using the de Broglie hypothesis, but there is a serious problem. De Broglie proposed these relations for a matter wave. However, Schrödinger handled the relations as applicable to an energy in general such as the kinetic energy, which a particle has. For an energy quantum, which is the energy per cycle, the relations hold. So, at first, let us take an energy quantum, and substitute the frequency by the energy and the wave number by the momentum in its wave function.

$$
E_{q}=\hbar \omega \quad \Rightarrow \quad \omega=E_{q} / \hbar
$$

$$
p_{q}=E_{q} / v=\hbar \omega / v=\hbar k \quad \Rightarrow \quad k=p_{q} / \hbar
$$

The above wave function is transformed to the below.

$$
\psi(x, t)=A\left(\cos \left(\frac{1}{\hbar}\left(p_{q} x-E_{q} t\right)\right)+i \sin \left(\frac{1}{\hbar}\left(p_{q} x-E_{q} t\right)\right)\right)
$$

In order to obtain a differential equation giving this as a solution, we take partial differentials by $t$ and $x$, and obtain operators for the energy and the momentum. The formulas of the operators are the same between the Schrödinger case and the ECT. However, in the ECT, the applicable energy is limited to an energy quantum.

If we substitute these operators to an equation containing an energy and a momentum, then we can obtain a wave equation which we seek. As I noted already, the energy location is the same for all of the total energy, kinetic energy, mass, momentum and so on. Therefore, the equation to be substituted can be on any kind of energy. A wave function once obtained as a solution can be applied to any kinds of energy. Firstly, I introduce the equation in the ECT. The energy quantum, which is the energy per cycle, of the elementary single circulation is shown by

$$
E_{q}=m_{q} c^{2}=m_{q}\left(v^{2}+C_{r}^{2}\right)=\hbar \omega
$$

, where $m_{q}$ is the mass of the energy quantum. The linear motion component of this energy quantum is expressed as follows using the momentum of the linear component.

$$
E_{v}=m_{q} v^{2}=\frac{p_{q}^{2}}{m_{q}}, \quad\left(p_{q} \equiv m_{q} v\right)
$$

If we substitute the energy and momentum operators to this equation, we get the following wave equation.

$$
i \hbar \frac{\partial}{\partial t} \psi(x, t)=-\frac{\hbar^{2}}{m_{q}} \frac{\partial^{2}}{\partial x^{2}} \psi(x, t), \quad m_{q}=E_{q} / c^{2}
$$

Schrödinger, on the other hand, chose the kinetic energy formula as the original equation.

$$
E_{k}=\frac{1}{2} m_{r} v^{2}=\frac{1}{2} p v=\frac{p^{2}}{2 m_{r}}
$$

Substituting the operators to this, he got the Schrödinger equation shown below.

$$
i \hbar \frac{\partial}{\partial t} \psi(x, t)=-\frac{\hbar^{2}}{2 m_{r}} \frac{\partial^{2}}{\partial x^{2}} \psi(x, t)
$$

Although this is difficult to understand since it is a partial differential equation containing the imaginary unit $i$, it is enough to just take that the aforementioned wave function is a solution of this equation. If you are interested in the concrete derivation, please refer to \#28-\#30 of Capricious walk to physics.

## 17. Contradictions of Schrödinger equation

The Schrödinger equation and the wave equation from the ECT have the same form, and only the denominator in the coefficient part differs; $2 m_{r}$ or $m_{q}$. However, there is an essential and significant difference here. In the ECT, $m_{q}$ is the mass (intrinsic energy) of an energy quantum given by $m_{q}=E_{q} / c^{2}$, and is determined only by the linear velocity $v$ ( $E_{q}$ and $\omega$ are determined by $v$ ). On the other hand, the Schrödinger equation treats as that $m_{r}$ is the rest mass of an individual particle and varies with the particle of interest. It is argued that the larger the mass of a particle is, the higher the frequency of a solution wave function is.

In the ECT, all quantum particles such as proton, neutron and mesons are a composition of elementary circulations in a spacia. So, the wave function and the wave equation are the same for all quantum particles not only the space-space circulation $S$, on which we described so far. The amplitude of wave functions is constant as $\mu_{0}$. The frequency $\omega$ is determined only by the velocity $v$ of a linear motion component.

There are contradictions in the Schrödinger equation. (1) Although he used the relation $E=m v^{2}=p v$ on deriving the energy / momentum operators, he used the different relation $E=m v^{2} / 2=p v / 2$ as the equation, to which the operators were substituted. It may be argued that this should be the essence of the de Broglie hypothesis to show the wave-particle duality, but this is a clear contradiction. (2) Furthermore, the orbiting speed of an atomic electron is close to the light speed and the kinetic energy can no longer be approximated as $E=m v^{2} / 2=p v / 2$ (from the ECT but not from the special relativity). (3) Since the position of the kinetic energy is the same as that of the particle, it may make sense to take the kinetic energy as a wave accompanying the particle. However, they confuse the rest mass of the
particle, which is used in the kinetic energy representation, with the mass of the assumed matter wave. It is necessary to examine what the mass in the wave equation means. Since de Broglie hypothesis uses $E=\hbar \omega$ in addition to $E=p v$, the object must be an energy quantum. Therefore, it is an obvious mistake to take $m$ in the Schrödinger equation as a rest mass of a particle.

## 18. Achievements of quantum mechanics

Quantum mechanics, which was firstly formularized by the Heisenberg and Schrödinger equations, is said to have achieved great results such as the elucidation of atoms, molecules, and elementary particles. However, the fruits were on chemistry such as atomic and molecular orbitals, and contributed greatly to the elucidation of chemical structures and reactions. As for elementary particles, which will be discussed in the next chapter, although the particle model based on the field quantum theory has been proposed, it has serious problems and cannot be said to have progressed successfully.

Atomic orbitals are the only case in which a wave function of an object is obtained from a solution of the wave equation. Even so, those functions are not that with time $\psi(x, y, z, t)$ mentioned so far, but $\psi(x, y, z)$ without time. The Schrödinger equation can be divided to the space-dependent part and the time-dependent part. The solution of the space-dependent part corresponds to the amplitude of a time-dependent vibration. A linear motion of an electron gets to orbit due to the electric attraction with a proton. Quantum conditions are added to the orbiting, and discrete energy levels and unique shapes of orbitals are allowed. The energy here is not the energy of an electron as a whole particle, but is the electric potential energy due to the attraction with a proton.

On the other hand, in the ECT, the wave function shows the energy distribution of an elementary circulation, which composes a particle, and is given theoretically not as a solution of an equation. For an atomic electron, the new quantization condition for orbiting was presented, and the wave functions of an orbiting electron as a time-dependent full form $\psi(x, y, z, t)$ were given from the wave function of a linear motion. A rotation of an orbiting plane gave a 3-D orbital. In this way, the ECT shows a complete wave function that shows the energy distribution of an electron in an atom. In existing quantum mechanics, the spherical symmetry is given to the solutions,
but such a symmetry cannot be given willfully without showing a stationary wave including time. The ECT presented the corrections to existing atomic orbitals in concrete (\#27 of Capricious walk to physics). A wave function in the ECT is a solution of the wave equation but is a logical reduction made before that. A solution of a wave equation is not necessarily a real physical object.

## 19. Runaway of quantum mechanics

The big question was what the wave function, which is a solution of Schrödinger and Heisenberg equations, showed. What was the matter wave by the de Broglie hypothesis? Schrödinger, at first, interpreted that the wave function of an electron shows the distribution of the electric charge in the real space. However, Bohr and Heisenberg proposed a probability interpretation that the wave function shows the existence probability of a particle, then it was widely accepted. Why was such an interpretation made? One possible factor is the following. A point mass where a mass converges at one point and a point charge where an electric charge converges were vaguely thought of. From the formula showing the gravity, the mass will gather in the infinitesimal area (singularity) and show an infinite density, if it is not circulating. There is a possibility that they tried to get a spread of energy with an existence probability distribution of a point mass. But as a bigger factor, they seem to have stretched the meaning of the wave function from mathematical properties of the wave equation.

This wave equation is a linear partial differential equation, so what a solution is multiplied is also a solution. Furthermore, a linear combination of plural solutions by any ratios is also a solution. Are all the wave functions obtained as a solution those to be sought physically? A complex wave can be represented as a linear combination of simple plane waves. Further, a superposition of waves of plural frequencies can create a pulse-like stationary wave packet. I guess, they considered the wave function of a particle as a stationary wave packet obtained by superposing many plane waves, and tried to get a large degree of freedom by treating it as a wave of the existence probability. They did not mind amplitudes of individual plane waves, but requested that the integration of the square of the absolute value of the
superimposed wave function $\psi \psi^{*}$ over the entire space should be one. They called this adjustment of amplitude as the normalization.

Here another runaway joined. Originally, it should have been a wave equation for the purpose to obtain a desired wave function, but they turned to regard that a wave equation is the essence of a physical quantity. The left side of the Schrödinger equation on the page 29 is the energy operator itself obtained by partially differentiating the wave function, and is equal to $E \psi . E \psi$ indicates that $\psi$ is multiplied by a real number $E$, which is the amount of an energy. If the differential operation part is written as $\widehat{H}$ (Hamiltonian), the right side becomes $\widehat{H} \psi$. This means to apply the operator to $\psi$. $\widehat{H}$ is an energy operator, but for all physical quantities not only an energy, if an operator $\hat{A}$ is applied to a wave function $\psi$ showing a state, a measured value $a$ is obtained, they argued. It is shown by $\hat{A} \psi=a \psi$, that is, applying $\hat{A}$ to $\psi$ is equal to what the $\psi$ is multiplied by $a$.

The runaway leaps further. The wave function $\psi$ that shows a state is a set (superposition) of an infinite number of wave functions $\psi_{i}$, and a concrete wave function is determined only by a measurement, they insisted.

As explained so far, the existing quantum mechanics has proposed outlandish concepts by making leaps and bounds, rather than a logical accumulation. Instead of arguing about the correctness, physicists have argued that accepting these esoteric properties of the quantum mechanics as they were proposed is an understanding of the essence of it. Even if we cast doubt on the probability interpretation of the wave function, they will say that it has been experimentally proven for 100 years, and that it is already established and correct. Is physics good under these states? It is necessary to perform a logical verification from scratch.

## 20. Fiction of the uncertainty principle

Heisenberg, who had proposed the probability interpretation of the wave function, sought a background to support it. Focusing on the properties of waves, he released the uncertainty principle in Y1927. He argued that the spread (standard deviation) of the position of a particle and that of the distribution of its momentums have the following relation, and that it is impossible to give the position and the momentum accurately at the same time.

$$
\Delta x \Delta p \geq \hbar / 2
$$

The uncertain relation had been known as a property of classical waves. For example, in the case of one cycle of a plane wave with a single frequency (wave number), the positions of the vibration (energy) are dispersed over the entire wavelength. However, a mixed wave (wave packet) of plane waves with plural frequencies (wave numbers) has a narrow width of the vibrating positions, and a pulse-like wave packet is also possible. The spread of the vibrating positions and that of the wave number distribution have the following relation.

$$
\Delta x \Delta k \cong 4
$$

Substituting the formula $p=\hbar k$ of the de Broglie hypothesis to this, we can see that it corresponds to the previous formula (the way $\Delta$ is taken differs between the two). Therefore, the formula of the uncertainty principle is expressing the uncertainty relation of waves by the momentum instead of the wave number. But there are prerequisites here. The object must satisfy the relation $p=\hbar k$, that is, both $E=m v^{2}=p v$ and $E=\hbar \omega$. At least, it must be an energy quantum (energy per cycle). For an object that satisfies the conditions, the uncertainty principle holds true.

The uncertainty relation holds true also for an energy circulation in the ECT. If the intrinsic energy $m$ is circulating at the frequency $\omega$, it can be also expressed as $4 m$ is circulating at $\omega / 2$, and as a mixed wave of plural harmonic waves as well. Therefore, the position of the energy and the wave number (frequency) of its vibration cannot be determined simultaneously. However, in an energy circulation, the position of the energy on the circumference shall not be specified but treated as uniformly distributed. It does not have to be strictly uniform, and neither the non-uniformity nor the fluctuation can be determined. The position indicated by the wave function shows only that of the linear motion component without specifying that on the circumference but with the radius fixed as $\mu_{0}$. Therefore, the uncertainty relation can be disregarded for the internal circulation. The position of the circulation is fixed at the center while it has a width of the radius $\mu_{0}$. The position of the linear motion is given by $v t$, and points to a point at a given time. The frequency and the wave number are also determined only by the linear velocity $v$. Therefore, the position and the wave number of a particle can be determined
at the same time, and the uncertainty relation does not hold. So, the uncertainty principle does not hold true for the position and the momentum of a particle expressed by the wave function.

The uncertainty principle is often explained by the non-commutativity of operators in addition to the above explanation on the wave packet. Although the explanation is skipped here, the commutativity does not give a basis for the uncertainty principle but merely describes it. For a detailed explanation, please refer to \#31 of Capricious walk to physics.

Once the uncertainty principle had been accepted, it escalated further. Although originally, the uncertainty principle was that the position and the momentum cannot be determined at the same time, it came to be grasped that there is uncertainty in the position alone and that the position $x$ is given by the operator $\hat{X}$ to give a position as $\hat{X} \psi=x \psi$. Despite using the position operator, which is selfish, they gave a range of the uncertainty arguing that any subjects of measurement cannot be determined at the same time if their operators are mutually non-commutative. One of them is the measurement of the energy and the time interval. Based on this uncertainty, it was claimed that a high-energy boson particle that mediates a force can be generated since a high-energy state can be taken if it is for an extremely short time. The energy is a perfectly conserved quantity over time and never takes on high values even temporally. When there are multiple energies, energy may concentrate on a part and it becomes a high energy, but the total amount of the energies is unchanged. The convenient uncertainty principle, combined with the gauge field theory to be mentioned in the next chapter, yielded convenient charges, field-quantized bosons, etc., and led to a runaway to the standard particle model.

## Ch.4: Particle Theory

## 21. What is the particle

In the standard model of particles, it is not defined what a particle is. It claims the existence of the 17 fundamental particles called as the elementary particles that cannot be divided further. Each particle has various charges and quantum numbers (electric charge, spin etc.). Without questioning "why elementary particles with such properties exist" or structures of them, it is claimed that secondary particles consisting of them and the decay or collision reactions can be explained if those elementary particles are assumed. The standard model treats each elementary particle as a point particle with no size. The wave function to show the existence probability in quantum mechanics, which was discussed in the former chapter, is not given for an elementary particle itself.

In the ECT, the term "particle" is defined as an energy circulation. An energy circulation is formed by the intra-circulation interaction based on the fundamental force. By the circulation, the position of a particle can be static to the space energy at the center. Particles show the properties as a particle such as attraction or repulsion with other one due to the interaction by the fundamental force. As explained on the page 22, the ECT logically represents the wave function to show the energy distribution of an elementary circulation (particle). Here are shown again the distribution and the amount of the energy of a static single circulation.

$$
\begin{aligned}
E_{(i S)}\left[\begin{array}{ll}
X & H]
\end{array}\right]=E_{(i S)} \psi_{0}=E_{(i S)} \mu_{0}\left(\cos \omega_{0} t+i \sin \omega_{0} t\right) \\
E_{(S)}\left[\begin{array}{ll}
X & Y]=E_{(S)} \psi_{0}=E_{(S)} \mu_{0}\left(\cos \omega_{0} t+i \sin \omega_{0} t\right) \\
& E_{(i S)}=E_{(S)}=m_{0} \mu_{0}^{2} \omega_{0}^{2}=m_{0} c^{2}
\end{array} .\right.
\end{aligned}
$$

$\mu_{0}$ and $m_{0}$ here are the radius and the intrinsic energy (mass) of an elementary circulation, and are derived from those of the spacia. These two are invariant by the space expansion, and role as the fundamental constants in the ECT.

## 22. Quark model

At some point in the early days, the baryons like proton and neutron were considered as an elementary particle. But, since so many baryons were discovered, it was expected that there should be particles more fundamental
composing them. In Y1964, Gell-Mann and Zweig separately proposed the hypothesis that a baryon should consist of three fundamental particles, which later came to be called as a quark. It proposed that proton and neutron consist of the up-quark $u$ and the down-quark $d$, and that the electric charge of $u$ is $+2 / 3$ of the elementary charge $e$ and $d$ has $-1 / 3$ that. A proton has a composition of uud and an electric charge of +1 e . A neutron has that of udd and its electric charge is zero. This is a hypothesis and has no theoretical basis. A big question is why is such a fractional charge of e possible? Before that, in the standard physics, what is the origin of the electric charge is not touched at all and is shelved. A more critical problem is that the mass of a nucleon cannot be predicted by those of the quarks. Since each elementary particle is assumed to exist, its mass cannot be calculated theoretically. It is obtained as a measured value by observation. However, the mass of a particle, which is a composition of elementary particles, should be roughly derived from those of the composing ones. The masses of quarks were initially given as a fairly large value, but they have been decreasing; currently $2.2 \mathrm{MeV} / \mathrm{c}^{2}$ for $u$ and $4.7 \mathrm{MeV} / \mathrm{c}^{2}$ for d . The mass of proton is $938 \mathrm{MeV} / \mathrm{c}^{2}$, which cannot be explained by those of quarks. The origin of the proton mass has been a subject of research. In one report it was claimed that the contribution to the proton mass was $36 \%$ from the energy of the glue field, which mediates the force between quarks, and $32 \%$ from the energy (including kinetic energy) of quarks. Under these circumstances, can we claim that quarks are the fundamental particles that compose a baryon?

## 23. Structure of neutron and beta decay by ECT

In the 4-D space including the hidden dimension $H$, there are six planes orthogonal to each other; $\mathrm{XY}, \mathrm{YZ}, \mathrm{ZX}, \mathrm{XH}, \mathrm{YH}$ and ZH . Within a single spacia, energy circulations can enter in these planes, which we call as the quantum particle. Let us consider the case where each single circulation is in two planes.


$$
2 S \rightarrow D(S: \bar{S}) \text { or } 2 i S \rightarrow i D(i S, \overline{i S})
$$

(a) Two space-space circulations, or two hidden-space circulations

(b) One hidden-space and one space-space circulations

As shown in the above figure (a), between to two $S$ or two $i S$, an attractive force acts in the direction of the arrow and a repulsive one acts in the area without an arrow, then the two rotate and form a coupled conjugate pair (double circulation). On the other hand, $S$ and $i S$ cannot rotate to a mixed direction of the hidden dimension and the space dimension. Therefore, the two circulations do not rotate to a mixed direction but attach each other at the ends as shown in (b). An overlined symbol of a circulation indicates that the direction is $-\omega_{0}$ opposite to $\omega_{0}$. The ground state of an elementary circulation has the frequency $\omega_{0}$, but an excited state with an integer multiple of $\omega_{0}$ is also a quantized stable circulation. We denote the double circulations with $2 \omega_{0}$ as $D^{\#}$ or $i D^{\#}$.

The space-space single circulation $S$ is not stable on its own, and divides into two ones, which go to opposite directions. We call it as a hemi-circulation expressed by $H$. Since $S$ is the minimum energy that can be quantized, $H$ cannot be stationary and moves at a velocity close to the light speed. The energy of its internal circulation gets close to zero. These $H$ and $\bar{H}$ are the neutrino and the antineutrino. The repulsive force that acts immediately after the division is so called the weak force, which is an orthogonal interaction between two energy circulations. Since their circulations are in the same direction, the force is repulsive.

$$
S \rightarrow v(H)+\bar{v}(\bar{H})
$$

In the case of iS in hidden-space dimensions, it cannot move in the hidden dimension, and can move and prolong only in space dimensions. In $i S$, it is approximated that the $+e$ and $-e$ charges are located with the distance of $2 \mu_{0}$. When an energy is added to it and it prolongs in the space dimension, only the electric potential energy increases, and the electric charge, which is
the momentum in the hidden dimension, does not change. By the prolongation, the circulation is divided to plural ones as shown in the below figure.


When it prolongs to n ones, the following intra-circulation force acts between the two halves in each circulation.

$$
F_{x}=K_{e} \frac{(+e / n)(-e / n)}{\left(2 \mu_{0}\right)^{2}}=-K_{e} \frac{e^{2}}{\left(2 n \mu_{0}\right)^{2}}=-K_{e} \frac{e^{2}}{d^{2}}
$$

At adjoin places of two circulations, two forces offset and result in zero. So, the above force remains only at the two ends. This is equal to the force working between $+e$ and $-e$ charges at the distance $2 n \mu_{0}$. Please note that the number n of the prolongation is always an odd number. This is because an even number of $n$ results in a repulsive force and the energy decreases if it further prolongs, and an odd number results in an attractive force and requires energy for further prolongation. We divide the prolonged iS into the positive-charge part and the negative-charge part, and denote them as the hemi-circulations $i H_{+}$and $i H_{-}$. Just as $S$ and $i S$ attract and attach, $H$ attaches to the end of $i H$. The adduct of $H$ (neutrino) and $i H_{-}$is the electron.

$$
\text { Electron: } e^{-}=\left(H, H_{-}\right)
$$

For almost all major particles, the ECT predicted the composition of energy circulations and theoretical values of electric charge, spin, energy and rest energy, all of which showed a good fit to observed one. (Ref. Quantum particles based on ECT)

While the neutron is stable in a nucleus, it is unstable by itself and undergoes the beta decay with a life time of 15 minutes, and transforms into a proton, an electron and an antineutrino. The neutron has the following composition.

$$
\text { Neutron: } n^{0}=\left(D^{\#}, D, D, i S\right)
$$

The double circulation $D$ is a coupled conjugate pair $S: \bar{S}$, but once the two circulations separate to the adjacent position, they move away irreversibly from there due to a repulsive force (see the figure on p18). This is why the
neutron is unstable by itself. The beta decay of the neutron occurs in the following two steps.
(1) $n^{0}\left(D^{\#}, D, D, i S\right)+\Delta E \rightarrow p^{+}\left(D^{\#}, D, \bar{S}, i H_{+}\right)+a^{-}\left(S, i H_{-}\right)$
(2) $a^{-}\left(S, i H_{-}\right) \rightarrow e^{-}\left(H, i H_{-}\right)+\bar{v}(\bar{H})$

The first step is the separation of $D$ and the prolongation of $i S . a^{-}$here is a new particle, which I named as the anon. This reaction is due to the strong and the electric interactions. The second step is the decomposition of $S$ in the anon into a neutrino and an antineutrino, which is due to the weak interaction. The neutrino adds to $i H_{-}$and forms an electron. The antineutrino is released to the opposite direction. The position of the electron is that of the neutrino, but the charge $-e$ of the electron is dispersed from it to the proton. The charge $+e$ of the proton is also dispersed until the electron, but its position is that of $\bar{S}$ and the other circulations.

The $\bar{S}$ circulations in nucleons show a mutual attraction by the flat interaction. This $\bar{S}-\bar{S}$ interaction attracts two nucleons. Further, $s$ moves between $D(s: \bar{S})$ and $\bar{S}$, which stabilizes the nucleus. The below figure shows the force and potential energy on $S$ within a neutron and a proton. The horizontal axis is the distance of $S$ from $\overline{S_{1}}$ as a relative value treating the diameter $2 \mu_{0}$ as one.

Flat interaction $\overline{S S}-S$ by two $\bar{S}$ and one $S$

$$
S+\bar{S}+\bar{S} \leftarrow D(S: \bar{S})+\bar{S} \leftrightarrow \bar{S}+D(S: \bar{S}) \rightarrow \bar{S}+\bar{S}+S
$$




$\rightarrow \bar{S}_{1}$ at $x=0, \bar{S}_{2}$ at $x=1$
(a) Respective forces on $S$ (black) from $\bar{S}_{1}$ (red), $\bar{S}_{2}$ (green), sum (blue)
(b) Respective potentials of $S$ from $\bar{S}_{1}$ (red), $\bar{S}_{2}$ (green), sum (blue)

The red lines show the force with $\overline{S_{1}}$ and the potential energy, the green lines show those with the other $\overline{S_{2}}$, and the blue lines are the sums of the two cases.

In the standard model, the essence of the beta decay is shown as below.

$$
d \rightarrow u+W^{-}, \quad W^{-} \rightarrow e^{-}+\bar{v}
$$

$W^{-}$is a particle called as a weak boson, which mediates the weak force. Its mass is so big as $80 \mathrm{GeV} / \mathrm{c}^{2}$. They claim that a high energy state is possible if for an extremely short time from the uncertainty principle. However, as I explained in the section 20 , the uncertainty principle is wrong.

## 24. Gauge theory of particles

The standard model of particles is currently expressed with based on the gauge theory. The gauge theory is written in the advanced mathematics of the group theory, which is too difficult for me to understand. I would like to state below what I roughly grasp on what is being done in the gauge theory.

When a certain state 1 changes to a state 2, plural paths are considerable. The integral over time of the work done by this change is called as the action integral. There is the principle of least action that the path that actually occurs is the one whose action integral is the minimum. Since it is the minimum (extremum), the differentiation of the action by a deviation of the coordinates from the least path shall be zero. If there exists an action, it can be expressed as there is a field. The electric field is called as a scalar field since its charge is a scalar. The magnetic field is a vector field since its charge is a vector. Now we take a scalar field. If an action is invariant by a transformation such as a rotation of coordinates, the theory giving the field is said to be symmetry, which is called as a gauge symmetry. The gauge theory seeks a gauge symmetry for individual systems as an analogy to the principle of least action.

However, in the case of a scalar field, the action is no longer invariant for a local gauge transformation. Here, so call a covariant derivative is added to make the action invariant. This covariant derivative is a newly introduced field. When the scalar field is the electric field, the introduced field is the magnetic field, which is a vector field. The field in total is called as a gauge field. In fact, before the introduction of the gauge theory, the classical electromagnetism had already formularized the electromagnetic field, which included a scalar field and a vector field, as the electromagnetic potential.

The electromagnetism was found to satisfy a gauge symmetry, and the gauge theory came to the fore.

A quantized gauge field is a particle called a gauge boson, and the force acting on the field can be rephrased as that by exchanging the gauge boson, they claim. This is called as the quantum field theory. In the case of the electric force between charged particles, the quantized electromagnetic field is the photon, which mediates the force. The electromagnetic dynamics by the gauge theory is called as the quantum electrodynamics (QED).

In the case of the electromagnetic force, the gauge transformation that shows a gauge symmetry is $U(1)$, which is a rotation operation. $U$ is a unitary matrix, when by which an object is multiplied, it performs a transformation such as a rotation without changing the absolute value. The number in the parentheses indicates the dimension of this matrix. The special unitary group is a subgroup of the unitary group consisting of unitary matrices. $\mathrm{SU}(\mathrm{n})$ is the group of n-dimensional unitary matrices with the determinant is one. If we request the symmetry to the $\operatorname{SU}(2)$ gauge transformation, a gauge field by the weak force is generated. Its quantization gives three types of gage bosons; $Z^{0}, W^{+}$and $W^{-}$. The weak force is an interaction, in which the type of a quark changes. In the case of the beta decay of neutron, the charged $W^{-}$is the mediator particle. This dynamics is called as the quantum flavourdynamics (QFD). The weak interaction is treated as the electroweak dynamics (EWD) together with the electromagnetic force, and QFD is not often used. From the symmetry of the gauge transformation SU(3), they obtain the field of the strong force working between quarks, and its quantized field particle. This gauge boson is called as the gluon, has zero mass, and has a quantum value called the color charge. There are eight types of gluons depending on the color charges (a gluon has a mixture of two colors). A quark can take one of three color charges. The color charge is not a color of light, but is named so since it is expressed as white when three color values are mixed.

The standard model of particles requires the $\mathrm{U}(1) \times \mathrm{SU}(2) \times \mathrm{SU}(3)$ symmetry, and finds individual fields that satisfy the conditions of each gauge transformation, and express them in the form of the Lagrangian. The gauge boson is what is obtained by the field quantization, and is a particle mediating a force, they claim.

## 25. Problems with the gauge theory

There is a different algebra for each unitary group of gauge transformation. In general, individual groups have their own algebras associated with them. Each one contains its own axioms and operations. For example, the group representing all vectors must first define what a vector is, which becomes an axiom. Then, it defines the operations such as the addition and the multiplication in this group. If an object satisfies the axioms, it can be regarded as a vector even if it does not look like a vector at first glance, and the algebras in this group can be applied.

If we can express a particle as an aggregate of plural elements, which are elements of a certain group, the algebras of the group can be applied to this particle. In the gauge theory of particles, the elements that represent the elementary particles are not defined. Operations are expanded under the state where elements are undefined. A wave function that indicates the distribution of the existing probability of a particle is not given either. Sometimes, the particle composition is displayed in a matrix, with 1 indicating that each elementary particle is present and 0 indicating that it is absent, and the decay reactions and the interactions of particles are being developed. It too much conveniently introduces the creation and annihilation operators of particles. These weaknesses of the gauge theory are recognized by many physicists, and they say "the gauge theory would be $99 \%$ correct", but never say as $100 \%$. If we define the elements to assume, its algebras can be established. Take a case that certain elements are assumed and a theory is developed from them by mathematical logics. Even if it is mathematically correct, if the assumptions do not exist in reality, it is just a fantasy physically.

As for the electromagnetic force, you might think that the element is clear to be an electric charge. However, the gauge transformation is discussed subject that the element is a point charge. Shelving what the electric charge is, it is regarded as an absolute conserved quantity. In the ECT on the other hand, the electric charge is the momentum in the hidden dimension, and plus-minus pairs of the elementary charge are prolonged and dispersed in the space dimensions as explained on the page 38 . The elementary electric charge pair is not limited to electron and proton, but there are also various lengths of sole electric pairs. Rotation of the electric charge
pair produces a magnetic charge (magnetic field), which is a vector charge in the 3-D space.

In this way, the standard model has no basis for unconditionally assuming the 17 kinds of elementary particles, and does not say anything about the possibility of more fundamental constituents of them.

## Closing Remarks

In the above, I have been describing the problems of the modern physics. What kind of impression did you have? As for the theory of relativity, the light speed invariance, which is the premise of it, is wrong. The Hubble diagram data of supernovae strongly supports that the light speed has been decreasing due to the decrease in the medium density with the space expansion. In quantum mechanics, I have demonstrated that there are big contradictions in the derivation of the wave equation and that it is necessary to correct the equation and the interpretation of its solution; a wave function. While the uncertainty principle was proposed to justify the probability interpretation of wave functions, it cannot be applied to the position of a particle. The standard model of particles is developed with arguing that a high-energy state is possible for a very short period of time due to the uncertainty between the position and the time, but it is wrong. A gauge particle that mediates a force is introduced from the symmetry of a gauge transformation, but the algebra for the gauge transformation is being used without mathematically defining elementary particles. It is a doubt whether this algebra can be used for the elementary particles.

In this way, we have to say that the modern physics is broken down no matter how we look at it. They jumped at the novelty of uncertain proposals and accepted them without examining in detail the correctness of the content. It is said that the presence of the quarks has been proved, but they have never been found alone. They analyzed the data of collision experiments by the theory assuming quarks, and argued that there were quarks. It may be possible that the same data can be interpreted by a different theory. There is a big problem in ignoring this point and claiming that the existence of quarks has been proved. As for the observational results that are said to have proved the correctness of the theory of relativity, the same data can be explained by that the passage of time has been unchanged and the light speed has changed.

However, unless alternative physics are presented in concrete, they would not come to reexamine the existing physics from bases. The ECT this time started with the idea that there might be a force acting on the movement of energy, as oppose to the gravity acting on the amount of energy. This is
truly like a gift from the heaven. Starting with this hypothesis, we were able to rewrite the existing physics like a miracle. The new one by the ECT resolved many unsolved problems and showed a very good agreement with measured data. If they remove the spell that the existing standard physics is proven and absolute, and examine individual subjects in comparison with the ECT, they shall find which is correct or a direction of a new solution for each of them.
S. Nagao, Nov. 2022

