

# Polarization of Elementary Particle and Electromagnetism

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## 1. Abstract

As a result of insight that elementary particles are equivalent to vacuum space, (both made of the same material named energy body), the elementary particle model that has a character of field was made up. By this model, concrete images were given to electromagnetism's phenomena that are abstractly theorized by quantum mechanics. The shape of elementary particle model is like this; the wave of the energy body rotating around its own axis thinly and infinitely spreads out being attenuating from the central part in a spherical shape with high energy level. The central part in a spherical shape shows the character of a particle and the skirts part shows the character of field (electromagnetic field). And that gives elementary particles an important character of polarization. And more, when the two elementary particles draw close the difference of energy level of each wave works as interaction (electromagnetic interaction).

## 2. Introduction

It is already gotten the result that the energy body theory, which discerned that elementary particles are equivalent to vacuum space, can be "the theory of everything" that is the ultimate goal of physics. Among them, electromagnetism is focused on in this paper; which has been developed from the first stage of modern physics. And the weak points of the quantum theory that is difficult to have concrete images, (be abstract), will be conquered. As being previously stated, an elementary particle model in this paper is a particle, a wave, and also a field too. More, it is energy and mass too. The model includes all of these factors. It is not a model that can exist in just only an imaginary world but can exist in a real world. And it is the result from equivalence of elementary particles and vacuum space. By the way electromagnetic waves have a little different character from elementary particles which are minimum elements of matter. They are classified as a photon in gauge particle in quantum mechanics (Wikipedia<sup>1</sup>), but in the energy body theory they are considered as a secondary formation created by moving of electrons. Namely, electromagnetic waves are the imprints left in static energy body (space) because of the change of electron's posture and position in alternating current. Then, it was found that electric wave and magnetic wave is in a body. But there is a different point between electric field and magnetic field. Electric field is made of electrons or protons alone or together. On the other hand magnetic field is made of just only electrons. The reason is given by quantum mechanics that an electron has a character of magnetic dipole. (Sakamoto<sup>2</sup>) Meanwhile the energy body theory gives the reason that an electron has no magnetic pole, but the pair of electrons that each progression axis is opposite makes two magnetic poles. Here, there are notable points that the source of phenomena of electromagnetism is known six factors as of now, those are two electrodes (positive pole & negative pole), electric field, magnetic pole (magnetic dipole), magnetic field and electromagnetic waves, but the energy body theory asks for just three factors, the waves of electrons, of protons and electromagnetic waves. By the way, the cause of "Zeeman effect" is explained as an electric spin that is an intrinsic form of angular momentum with degree of freedom by quantum mechanics. "Zeeman effect" is the phenomenon that the spectrum is emitted and split into some spectra in magnetic field when electrons are heated. By this, as cause of magnetism, an electric spin was presumed. (Sakamoto<sup>2</sup>) But it is hard to make an image of spin. Meanwhile, in the energy body theory, the image of spin can be beautifully made up with the rotating waves and the character of polarization of electrons. Others, the reason of magnetic field generation; the cause of electromagnetic induction, electrical charge, and electron transition; the origin of electromagnetic interaction, are rationally explained by the elementary particle model of this paper.

### 3. Elementary Particle Model

Fig1 is an image of an elementary particle based on the properties of the energy body theory. The oscillation of the energy body that is rotating around its own axis forms into an elementary particle like a saucer shape as a closed wave. The closer the wave is to the axis, the higher the energy state, the shorter the wavelength and the higher the amplitude. As it moves away from the center, the energy level decreases, approaching the standard level. Theoretically, the base of these rotating waves has an infinite width. The central part in a spherical shape shows the character of a particle and the skirts part thinly and infinitely spreading out shows the character of field (electromagnetic field). The energy between the particle part and field area is very different. So, that is the reason why the character of a particle and a wave are not observed at the same time. It means that electrons have an important character of polarization similarly to light because of their skirt area thinly spreading out. This polarization of electrons plays very important role to resolve some phenomena of unknown origin. This character of polarization of electrons can be made sure by the result that interference fringes do not appear at some degree of slits, if “experiment of double slits” is conducted. Since the waves are closed, such energy bodies form independent energy body systems. Fundamentally, there is one type of wave frequency type for each type of elementary particle. Thus, more far away from the center, the wavelength gets longer. But there are times when elementary particles of different types (frequencies) form compound waves, creating another type of elementary particle.

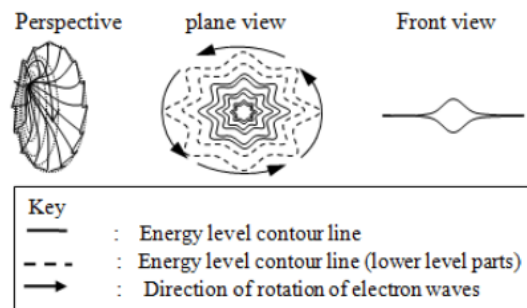


Fig1. Model of elementary particle by energy body theory

### 4. Electrical Charge

Presently, electrical charge is explained as follows.

Electrical charge is one of characters of elemental particles. Electrons have an electric charge of minus 1; protons have an electric charge of plus 1. The electric charge is the same, there is repulsion, and in cases where the charge is different, there is attraction. (Wikipedia<sup>3</sup>). But, the reason why electrons or protons have the character of electrical charge is not explained. That might be the reason that some insufficient points remain of understanding of electromagnetic field, though excellent results of studying phenomena. The model of elementary particles in this paper produces the reason with images for that. Electrical charge is the cause of electricity that is decided by the direction of the waves of elementary particles. Electrons are made of the closed waves that revolve to the left around the progression axis. In contrast, protons are made of the closed waves that revolve to the right around the progression axis. This causes the action of both the plus + 1 and minus - 1 electric charge.

### 5. Binding and Repulsion of Electron and Proton

#### 5.1. Propagation of Power

The propagation of power in a remote space is explained in quantum mechanics as there being an

electromagnetic field in this space, and force is propagated through the exchange of photons (emission and absorption). (Futamase<sup>4</sup>). But it intuitively gives a feeling of a slight strangeness. Because it is thought that the force should be directly propagated to the object. What does a photon (an imaginary particle) or magnetic field look like? You cannot draw their images, even though they are ones in the real world. Whereas, in the energy body model of elementary particles, force directly propagates to the object and binding and repulsion are drawn by physical images.

### 5.2. Binding of Electron and Proton

When protons and electrons draw close, between the electrons and protons; the electron waves that rotate left and the proton waves that rotate right go in the same direction. As a result, in this part, the speed of the waves becomes faster, wavelength extends, and the energy level drops. Thus, a force works from the center of the electrons and protons toward the space in between them, and the electrons and protons bind. Fig2.

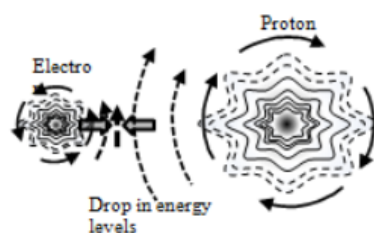


Fig2. Binding of electron & proton

### 5.3. Repulsion of Electron Pair or Proton Pair

When two electrons or two protons draw near to each other, between the two electrons or two protons, the waves of each electron or proton go in the reverse direction. For this reason, the speed of the wave then becomes slower, and the wavelength shortens. Then there is a rise in the energy levels between the two electrons or two protons, and a force works toward the center of the other electron or proton. As a result, the electron or proton pair repels one another. Fig3.

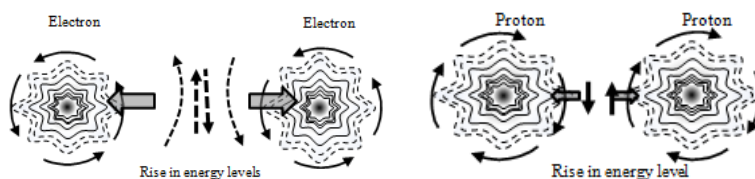


Fig3. Repulsion of electron pair and proton pair

## 6. Electron Transition

As explained above, when electrons and protons become close, wavelength extends, and there is a drop in energy levels, so electrons and protons may be thought to attach regardless of the distance, but this is not so. There remains one point to be considered. It is Bohr's quantum condition. The proton waves must be a numerical multiple integral of the number of nodes of electron waves. This is because the waves of the electron and proton in the bound part are shared, so closed waves would not be practical if nodes shifted position. The waves of electron and proton infinitely spread out with energy's continuously attenuating. The number of nodes of proton waves and electron waves is the same integer at any distance, regardless of the position from the center of the proton. Then, wave length gets longer in proportion to the distance. So orbits, which are the circumference of proton wave becoming the integral multiple of the nodes of the electron wave, appear at intervals. At the time, a character of polarization of elementary particles plays an important role. The waves of an

electron and a proton take parallel orientation each other, but do not cross at right angles. And, the electron inclines toward the horizontal plane of the proton, so it can only come into contact with the horizontal plane of the proton in one place. The choice of orbit of the electron is determined by the harmonic point of the speed of the electron rotating around the proton. Fig4.

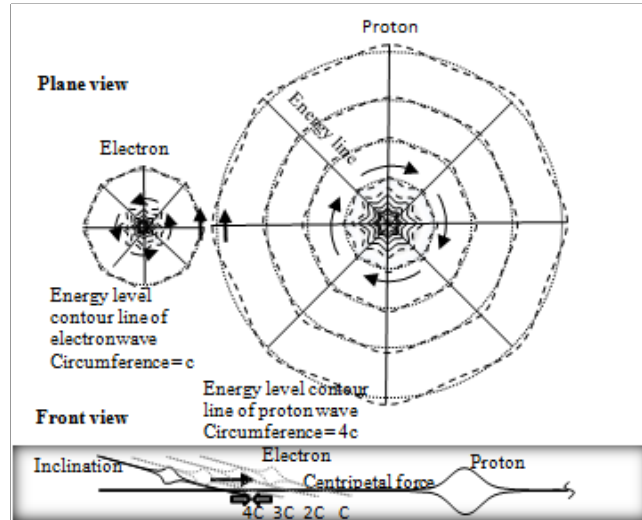


Fig4 Selection of electron's orbits tilting the posture at electron transition

## 7. Electric field and magnetic field

### 7.1. First

In electrodynamics explains electric field and magnetic field as follows. An electric field is a space that has its properties changed by electric charge. (Wikipedia<sup>5</sup> and Urushibara<sup>6</sup>). Also, when an electron placed in the electric field crosses the equipotential line perpendicularly, it affects the space, and a magnetic field is created perpendicular to the direction of movement of the electron. (Urushibara<sup>6</sup>). But, it does not explain why or how electrons can affect the space and change it to the field; and why or how magnetic field is created being perpendicular to the direction of movement of the electron. In other words the field is not imaginable. The energy body theory gives a solution to this question. By the way, it is already known that electric field and magnetic field is the same thing by Maxwell's equations. Furthermore, special relativity suggests that magnetic field is the same as the electric field gauged from another frame of reference. (Wikipedia<sup>7</sup>).

### 7.2. Electric Field

The energy body theory replaces electric fields with the spread of electron/protons' waves, lines of electric force with energy lines, and equipotential lines with energy level contour lines. The spacing of the energy level contour lines widens in the space between the electron and proton and it narrows on the opposite side, creating an electric field. Fig 5 shows the energy lines and energy level contour lines of electron 1 and proton 1

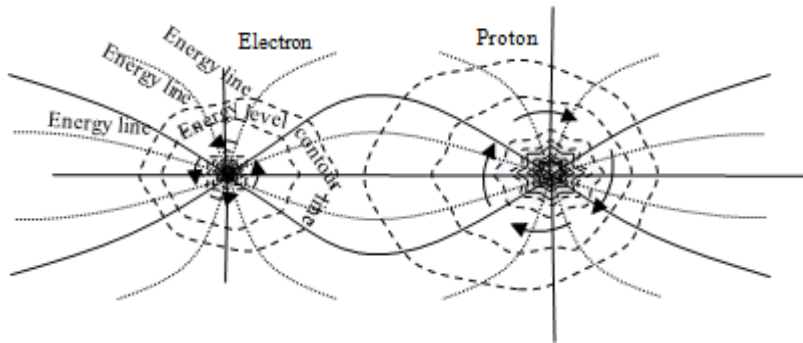


Fig5. Electric field & electric charge

### 7.3. Electric Current

The electrons in the electric field move to the protons. In regard to that, there are two reasons as follows. The one is a character of polarization. The free electrons inside wire moves in a free direction, However, because there are a countless number of electrons within the wire, if averaged as a whole, the flow of electric current becomes zero. When a wire is placed within an electric field, free electrons which are moving in a free direction (Wikipedia<sup>8</sup>), take a position where their orientation is parallel to the energy level contour lines because of a character of polarization. No position is taken in an orientation perpendicular to the energy level contour lines. The other one is a resultant force that is given from the direction of waves of electric field and waves of electrons. At the rear of the electron, the direction of the electron waves and the direction of the electron/proton aggregations' waves (energy level contour lines) are opposite, so the electron receives a repulsive force in the direction of movement. At the front of the electron, the direction of the electron waves and the direction of the electron/proton aggregations' waves are the same, so the electron receives an attractive force in the direction of movement. Thus, the force that works on electrons is repulsive at the rear and attractive at the front, becoming a resultant force of the vector of the same direction, and moving forward. The nearer approach the electrons to the protons, the stronger becomes the attractive force, conversely the weaker becomes the repulsive force. These are shown in Fig6 and Fig7.

### 7.4. Magnetic Field

Because of a character of polarization, an electron placed in the electric field crosses the energy level contour lines perpendicularly. It is affected by the different energy level contour lines, and tries to tilt perpendicularly to the direction of movement of the electron. In other words, there is an electron wave that rotates left around the electric current. This is a magnetic field.

Afterword, electric field and magnetic field are the same thing in the point of the waves of elementary particles. But there are different points between them. On the one hand, electric field is created by electrons and protons; on the other hand, magnetic field is created by electrons alone.

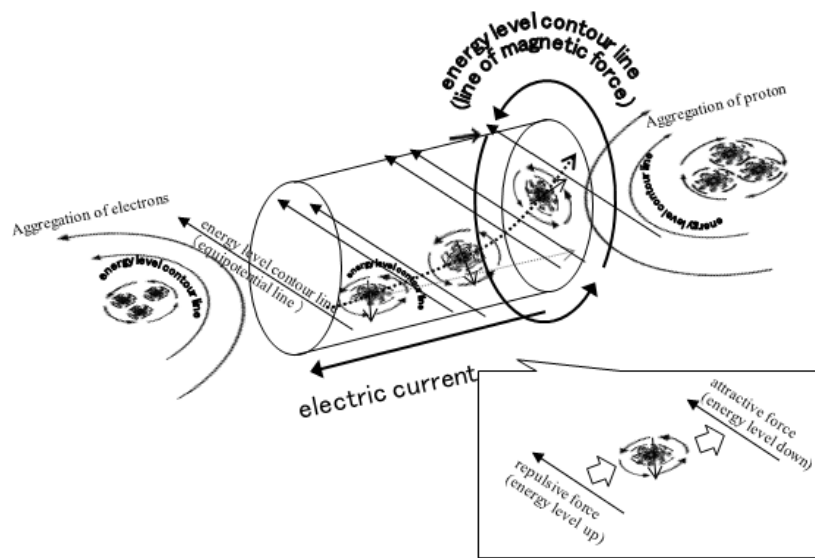


Fig6. Electric field, electric current, and magnetic field made by electrons' tilting movement

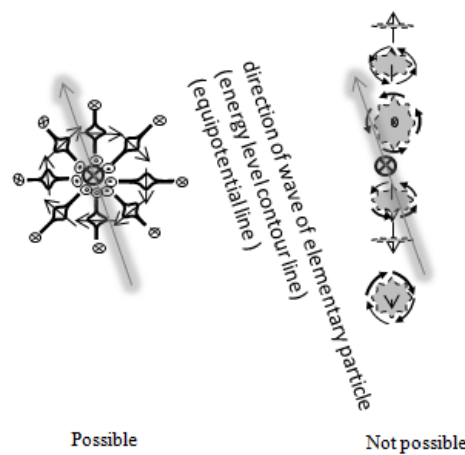


Fig7. Polarization of electron and energy level contour line in Electric field.

### 8. Magnetic Pole

It was explained a little while ago that magnetic field is created by just only electrons. But there is a question whether one factor alone can make two poles of N and S. In quantum mechanics, a spin of an elementary particle is the source of magnetic force and an electron itself has a character of magnetic dipole. But being different from electricity, a mono magnetic charge (N or S pole) is not able to take out. There is a possibility of existence for a mono pole particle. But it has not been found yet. (Sakamoto<sup>2</sup>). To this question, energy body theory gives a solution. To sum up, the point that the cause of magnetic force is electrons' spin is common to the quantum mechanics and the theory of energy body, but there is a different point between them if an electron has the character of magnetic pole or not. The energy body theory explains as follows. An electron itself has no character of

magnetic pole, but N pole and S pole are created by a pair of electrons that its progression axis is upside down each other. On Fig8 and Fig9, the state of an averaged electron in the solenoid coil is expressed, while electric current flows. If you look at the wave of an electron in the solenoid coil from one point, it looks as if there are two types of wave, clockwise and counterclockwise. Because, an electron turns its progression axis upside down while the electron goes around the one wire to the opposite side, then it looks as if the rotation of electron wave changes from clockwise to counterclockwise. Because of that, the rotating waves of electrons, (energy level contour lines), converge into the iron bar. That is S pole. Also they go out from the opposite side. That is N pole.

**When N pole and S pole draw near, the electrons' waves between N pole and S pole go in the same direction. So, the waves' length extends and the energy level goes down. Therefore attraction force works.** When N pole and N pole, or S pole and S pole draw near, the electrons' waves between the two same poles go in the reverse direction each other. So, the waves' length shrinks and the energy level goes up. Therefore repulsive force works.

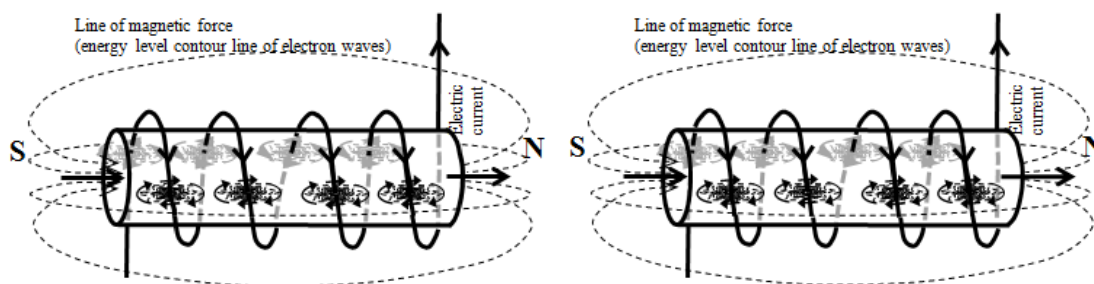


Fig8. Polarization of electron in solenoid coil and magnetic pole created

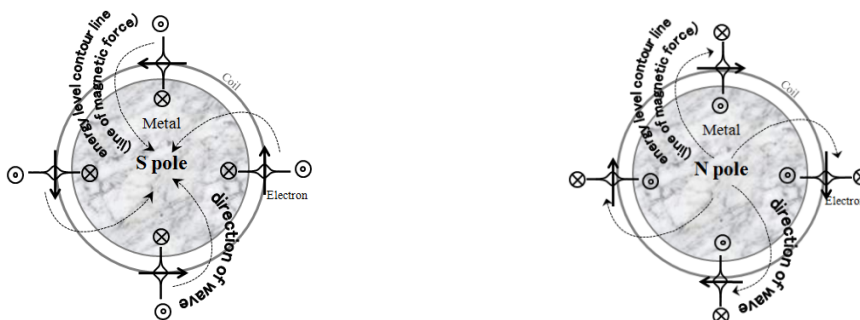


Fig9. S pole and N pole from side view of solenoid coil

### 9. Spin

If atoms are heated, the electrons in the atoms make transitions to lower energy orbital with the simultaneous emission of light. At the time if an atom is in magnetic field, a phenomenon is brought about that the one spectrum of light emitted from electrons is divided into some spectra. This phenomenon is explained by spin in quantum mechanics. Spin is one of fundamental characters of an intrinsic form of magnetic force. There are two types (up and down) in magnetic moment of an electron. Also, there are two kinds (increase and decrease) in the difference of energy level. From being mentioned above, an electrons' spin is not a momentum of mass but degree of freedom carried by elementary particles in quantum mechanics. (Sakamoto<sup>2</sup>). But the image of spin is vague. Then,

from now on, it will be explained using the instance of electrons by the energy body theory. As a result, a concrete image will be obtained. Fig10 and Fig11. An electron placed in the magnetic field takes a position at which its posture is parallel to the lines of magnetic force because of a character of polarization. No position is taken in a direction perpendicular to the lines of magnetic force. Fig11. Furthermore, electrons can take a position of any angle around lines of magnetic force. On Fig10, the positions of electrons are fixed at the place of side A or side B, but it does not take the position of side C or side D. At side A, the waves of an electron and a proton advance in the same direction; then the energy level goes down there. For that, the electron transits to the orbit of higher energy level. At the time, a light is emitted, because an instantaneous movement of an electron is imprinted on static energy body (space). This is the reason that the light is observed as emission spectra. As the light is created by just one movement of an electron transition, it has just one wave and one cycle; not continuous wave. There is a point to notice. That is a posture of electron transit. As an electron moves in the direction of progression axis of it, the infinitely spreading and rotating waves of electron are imprinted as it is. But wavelength of light observed as emission spectra is not the wavelength of rotating waves of electron, but the distance of electron transition. It might be easier if you think that one large board pushed static energy body in the direction of the front view. Light (also electromagnetic waves) is the transcription of movement or the change of electron's posture to static energy body. At side B, the waves of an electron and a proton advance in the opposite direction each other, then, the energy level goes up there. For that, the electron transits to the orbit of lower energy level. At the time, a light is emitted. The light emitted from electrons at side A gets more energy than the light from electrons at side B. For that, there are two types of magnetic moment that is increasing and decreasing. More, the electrons take the tilting posture up or down, because electrons select its orbit to adjust the nodes of waves each other.

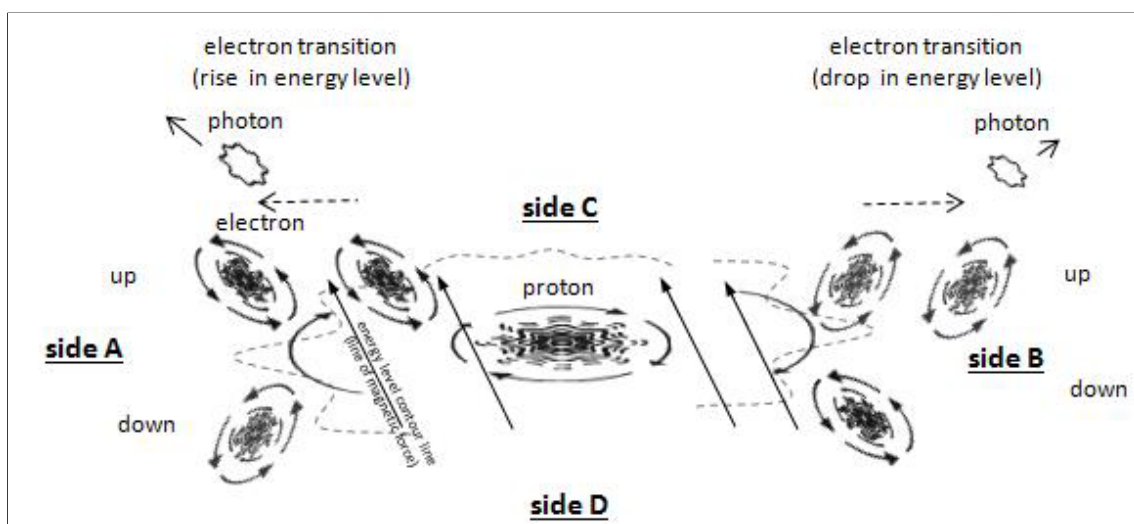


Fig10. “Zeeman effect” produced by electron’s spin; which means position and tilt of electron at atom depend on polarization of electron in magnetic field

Electrons do not take the position in a direction perpendicular to the lines of magnetic force. Figure11 shows that.



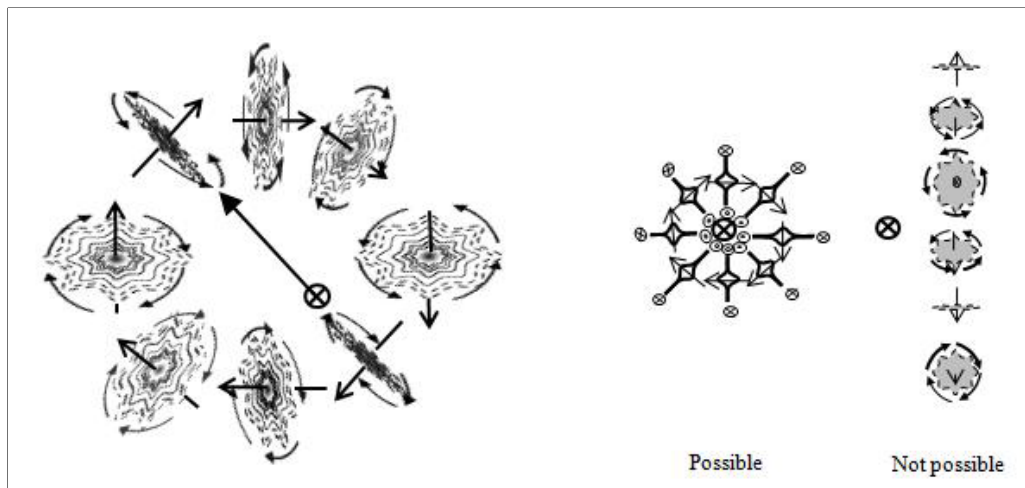


Fig11. Polarization of electron; posture of electron being parallel to the lines of magnetic force, not perpendicular

### 10. Electromagnetic Induction

If a wire is moved in a magnetic field, an electric current flows in the wire. (Sakamoto<sup>2</sup>). This phenomenon is historically studied in every respect from the first stage of the development of physics. Although that, it has not yet been made clear why an electric current starts to flow when a line is moved in a magnetic field. In energy body theory, this reason is explained in two points that are a character of polarization of electrons and a movement of electrons trying to tilt perpendicularly. Electrons inside one wire placed in a magnetic field takes a position at which its posture is parallel to the lines of magnetic force due to a character of polarization, as it was already described. It is shown in Fig12. And electrons start to move in the same way as in electric field. But one point is different..

Electric field is the place that energy level contour lines slant and there is difference of energy level between electrons and protons. On the other hand, in magnetic field, the lines of magnetic force are flat. Then, electrons move in a free direction around the lines of magnetic force. Because there are a countless number of electrons within the wire, if averaged as a whole, the flow of electric current becomes zero. More, it is needed to explain one more reason about the process that an electric current starts to move. Look at fig13. Postures of averaged electrons in one wire placed in a magnetic field are drawn at various angles. If the wire starts to move downward, the electrons' orbits which are moving upper right get more acute angle; and the distance to reach get shorter. On the other hand, the electrons' orbits which are moving downward left get more obtuse angle; and the distance to reach get longer. Inversely, if the wire starts to move upward, the electrons' orbits which are moving downward left get more acute angle; and the distance to reach get shorter. On the other hand, the electrons' orbits which are moving upward right get more obtuse angle; and the distance to reach get longer. From this, while the wire of motor makes one revolution, an averaged electron makes one revolution in the direction of advancing axis, and makes one cycle of alternating current.

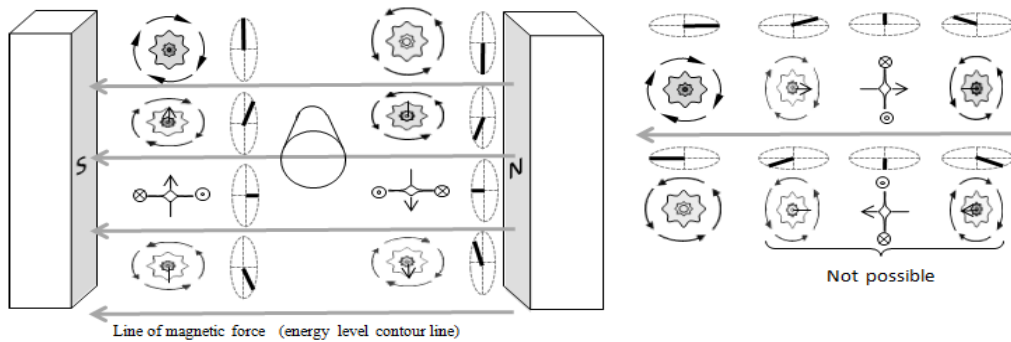


Fig12 Electromagnetic Induction; orientation of electrons in one wire placed in a magnetic field.

Next, the illustration Fig13 is the view of the wire from N pole side. It expresses electrons' possible posture in one wire in magnetic field.

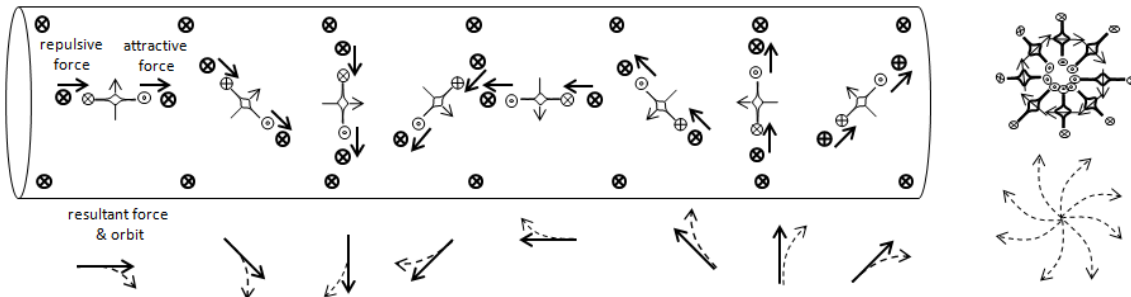


Fig13 Side view of a wire; orientation of electrons in a wire placed in a magnetic field.

Fig14 shows the orbits of electrons are gathered into one point from the ones at various angles. Broken lines stand for the orbits of electrons at the time the wire stops. Solid lines stand for the orbits of electrons at the time the wire go up, or go down. This is the cause of an electric current flow, when the wire moved in a magnetic field.

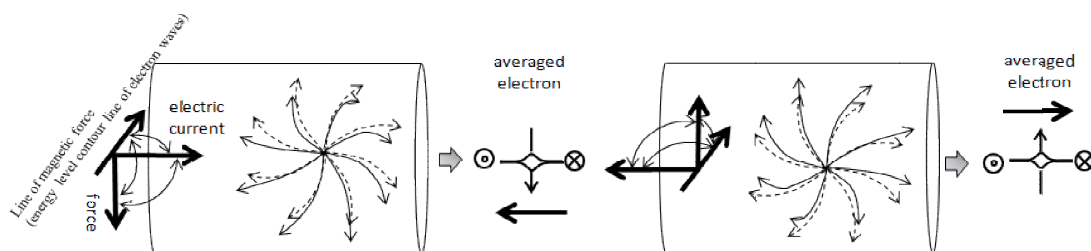


Fig14. Change of electron's orbit in a lead moving up or down.

### 11. Electroma

Electromagnetic waves are waves (undulation) formed by change in electric and magnetic fields of space. Electromagnetic field fluctuating along with time, which is generated by motion of electric charge or fluctuation of electric current etc, is propagated to space. As electric field and magnetic

field exist in empty vacuum space, electromagnetic waves are transmitted even in empty vacuum space where no matter exists as a medium for transmission. The direction of vibrations produced by electric and magnetic fields of electromagnetic waves are at right angles to each other, and the direction of movement of the electromagnetic waves is also at a right angle to this. ( Wikipedia<sup>9</sup>)

But, there remains a feeling being enveloped in smoke to read above explanation. The energy body theory will remove this smoke. As a sequel to electromagnetic field, electromagnetic waves are made clear by explanations with image. The detailed explanation is omitted to avoid taking long time. During one cycle of alternating current, an averaged electron makes one revolution in the direction of its advancing axis and makes one reciprocating motion. Electromagnetic waves are the result that the revolution and reciprocating motions of averaged electrons are transcribed to static energy body (space). It can be said that the revolution of averaged electrons is magnetic waves and their reciprocating motion is electric waves, but after all they are one body. It is the reason to be explained that electric field and magnetic field in electromagnetic waves are created in a direction perpendicular to each other. Therefore, naturally, the frequency of electric waves and magnetic waves are coincidence. The skirt area of electrons' wave rotating around its axis extends almost infinitely. For that reason, the electromagnetic waves that are transcribed from the change of orientation of electrons reach almost infinite distance at the same time as its generation. However, in reality, it is not the same time owing to the propagation speed of energy body (300,000km/sec). It is similar that one swing of a rod reach curving its tip. More, as electrons have a character of polarization, then it is natural that electromagnetic waves and light which are transcribed to static energy body from the change of orientation of electrons have the character of polarization. It is far easier to observe a polarization of electromagnetic waves and light than of electrons, because electromagnetic waves and light have a far less lump of energy at the center than electrons.

## 12. Conclusion

By energy body theory which discern "elementary particles are equivalence to space", fundamental phenomena of electromagnetism were rationally explained. Among them, especially important character of elementary particles' polarization will be confirmed by experiment. The understanding that "electromagnetic waves and light are created by the change of orientation of electrons being transcribed to space", will make the understanding of photon's mass deeper. Also, the concept assumed by theory of relativity, "The speed of light is nonetheless invariant, the same for all observers", will obtain a ground from the energy body theory.

## 13. References

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