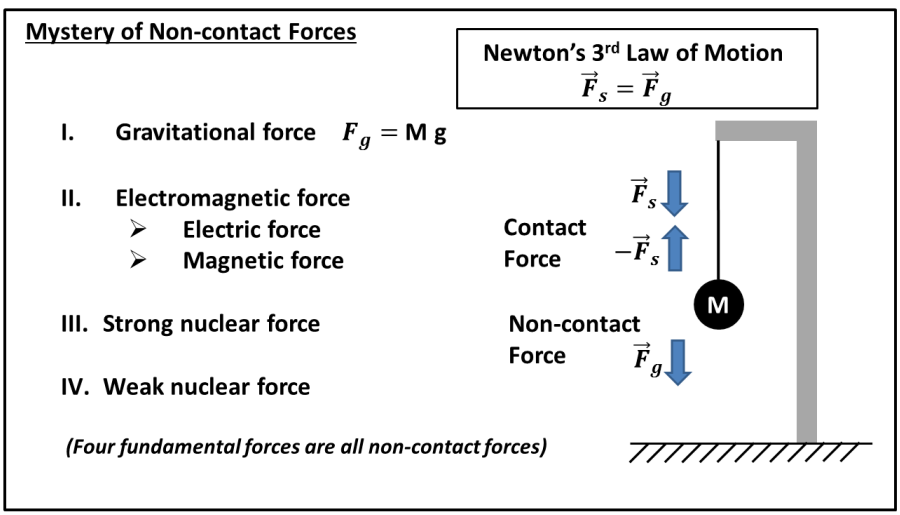
Chapter 1

Introduction

1.1 Mystery of Non-contact Forces

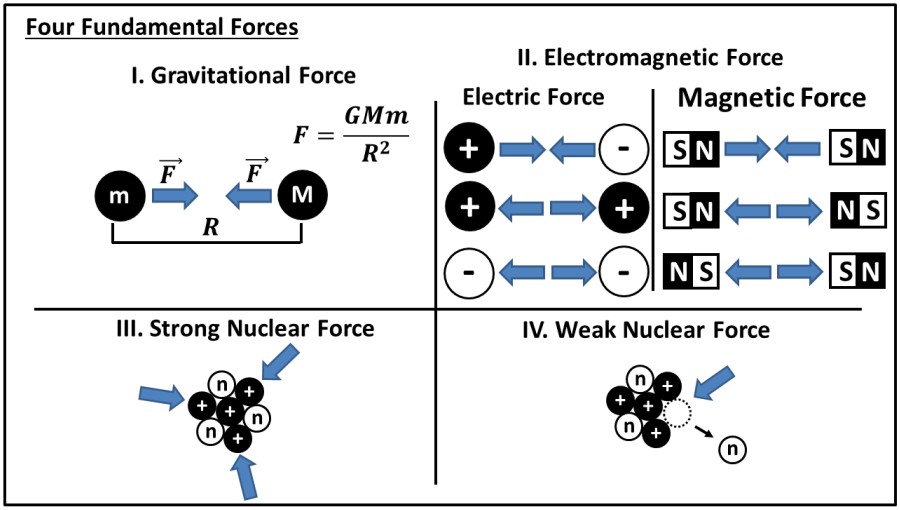


Newton's 3rd law of motion states that the reaction force is equal in magnitude and opposite in direction to the acting force. For example, a string is pulled on both ends. The pull forces have the same magnitude but occur in the opposite direction. They are contact forces.

If the string holds a stone and hangs on a pole, the string gives the stone a contact upward force. The gravitational force gives the stone a downward non-contact force. This type of non-contact gravitational force has never been explained mechanically in a way that most people can understand. Today, this force is still considered a mysterious force by many scientists.

We are so used to this gravitational force that we often forget to ask ourselves if we really understand it. This book will present an aether theory that can mechanically explain this mysterious gravitational force. And the theory is based on classical mechanics that we can truly understand.

1.2 Four Fundamental Forces

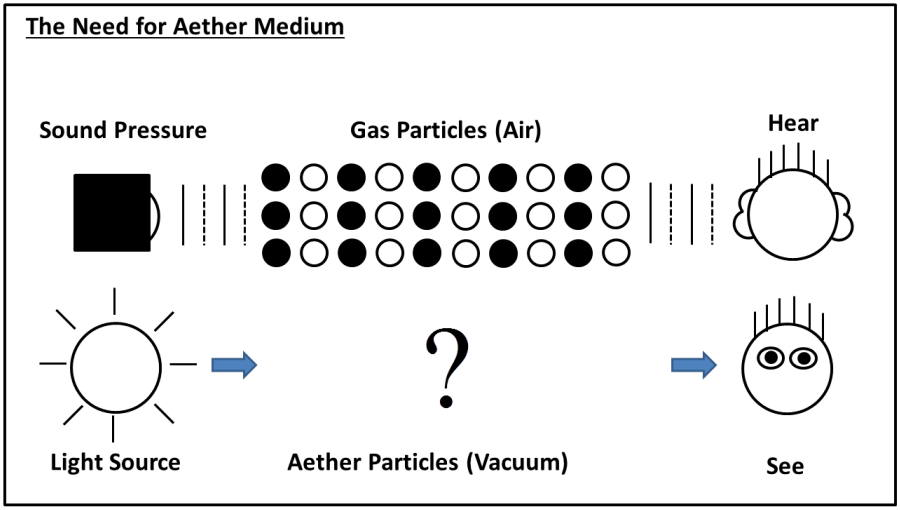


All four fundamental forces are non-contact forces or are called as action-at-a-distance forces.

1. Gravitational force is an attraction force between two objects with mass. According to Newton's universal law of gravity, the gravitational force is always an attraction force and is related to the mass of the object. No mechanical explanation is given without aether.
2. Electromagnetic force is another fundamental force. When the electromagnetic force is in oscillation, it produces electromagnetic waves or light waves. Electromagnetic waves are formulated by Maxwell's equations. Electromagnetic force can be decoupled into electric and magnetic forces. Electric force has attraction and repulsion forces between electric charges. Similarly, magnetic force also has attraction and repulsion forces between the north pole and the south poles.
3. Strong nuclear force is another fundamental force that binds positive charged protons together inside a small nucleus. This force is called strong force because people think the electric repulsion force of two positive charged protons at a small distance must be very strong.
4. Weak nuclear force is another fundamental force that causes neutrons to escape from the nucleus. Weak nuclear force is not as strong as strong nuclear force and electromagnetic force.

All four fundamental forces will be explained by the proposed aether theory.

1.3 The Need for Aether Medium

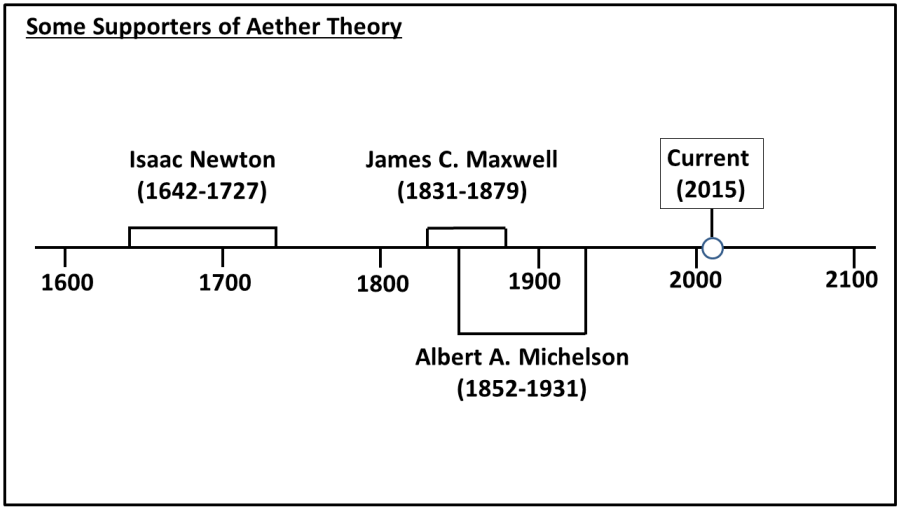


Ancient scientists believed a medium was needed for light or gravitational force to transmit from one place to the other. The scientists called this medium aether which means upper air in Greece. This prevailing aether exists everywhere in space including in the so-called vacuum.

A comparison of sound and light is made to show why ancient scientists thought aether medium was needed for transmitting light. Sound waves use the collision of air gas particles to transmit sound pressure from one place to the other. Without air, sound could not go anywhere. Similarly, light should also need a medium to allow light waves to transmit a light from source to us.

It is interesting to note that sound pressure is considered a contact force because of the colliding force among gas particles. However, electromagnetic force (light wave) is considered a non-contact force without aether particles. If aether is used to explain the transmission of light, electromagnetic force becomes a contact force.

1.4 Some Supporters of Aether Theory

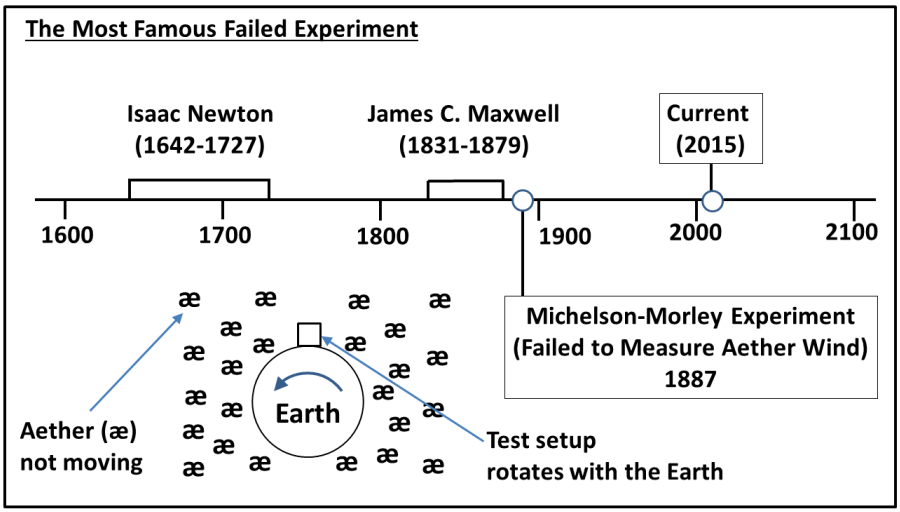


Isaac Newton (1642-1727) discovered and formulated the universal law of gravity. He believed aether must be present to cause the gravitational force. After many years of trying to explain the gravitational force with aether, he admitted he did not have a solid answer for it. It was almost impossible for Newton to connect the gravitational force and aether particles without knowledge of the kinetic theory of gases which was discovered in 1845. Aether Mechanics is developed from the kinetic theory of gases which considers colliding dynamic of gas particles. Even though Newton did not have the right tool (the kinetic theory of gases) to prove the existence of aether, he believed in its existence until the end of his career.

James C. Maxwell (1831-1879) formulated Maxwell's equations for electromagnetic wave and light. He also believed that electromagnetic wave and light could be explained with aether. After many years of trying to explain electromagnetic wave and light with aether, he did not have a solid answer for it. In his notes, he drew many aether flows in vortex motion. It seems that he considered the macroscopic vortex motion but neglected the microscopic spin motion of aether particles. Maxwell was a brilliant scientist. I believe Maxwell would have been able to explain electromagnetic wave with aether theory if he would have lived as long as Newton.

Albert A. Michelson is another important scientist in the history of aether theory.

1.5 The Most Famous Failed Experiment

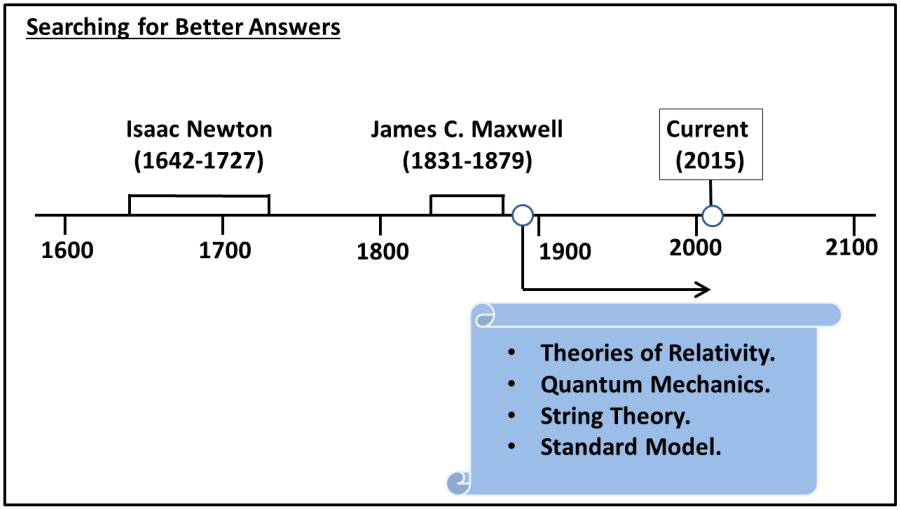


Albert A. Michelson and Edward W. Morley setup an experiment to measure the velocity of aether wind on the surface of the earth. It is known as the FAMOUS FAIL experiment. It is called FAIL, because this experiment fails to measure what they planned to measure: the aether wind. It is FAMOUS, because its null result, which mean zero velocity of aether wind, has been used as evidence to prove that aether theory is wrong. After the scientists thought that aether theory was wrong, they abandoned it and eventually rejected aether theory from scientific society.

The basic ideal of Michelson-Morley's experiment assumes aether does not move along the rotation of the earth. Therefore, there will be some relative velocity between the aether medium and the surface of the earth. There are many debates regarding whether the aether medium moves along the surface of the earth or not. Dayton C. Miller also considered that factor and did another similar experiment at a mountain above sea-level. The results obtained from that experiment were even more controversial than the ones at sea-level.

The bottom line is that aether is very difficult to be clearly detected due to the size of the particles. With more resources and attention, the question of the existence of aether could be better justified in the future.

1.6 Searching for Better Answers



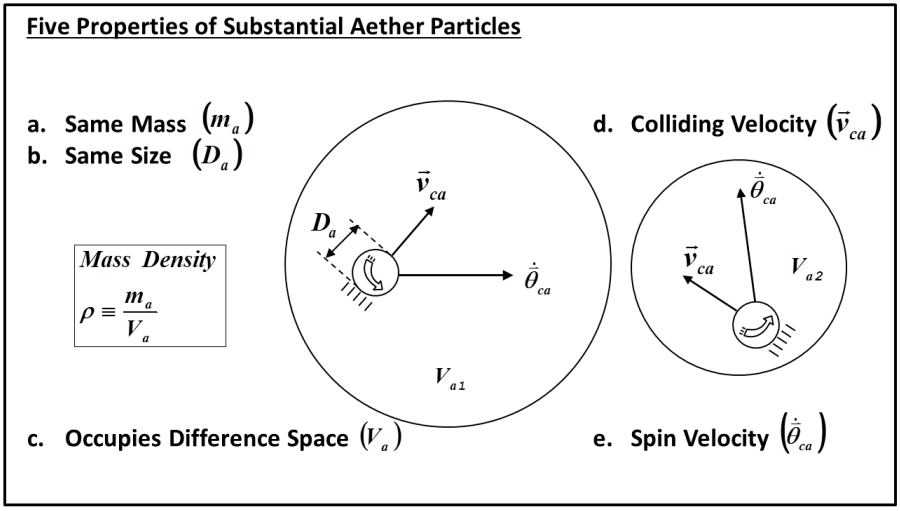
After the abandonment of aether theory, many theories and models were proposed. Some of the more famous theories and models proposed include the theory of Relativity, Quantum Mechanics, String theory and Standard model. These theories not only reject aether theory but also reject Newton's laws of motion based on Classical Mechanics. In general, these theories are incompatible with Newton's laws of motion and are usually difficult to understand.

Instead of being based on Classical Mechanics, modern theories are usually built on Mathematics and Statistics. Many equations have been developed. Yet, the root-cause of such equations has not been explained. Because the root-cause of the fundamental forces has not been identified correctly, these theories sometimes end up being inconsistent with each other.

The bottom line is that these modern theories can each describe some Physics phenomena. However, the fundamental forces are still not truly understood.

Because there is still room for improvement in today's science, a comprehensive aether mechanics is proposed in this book.

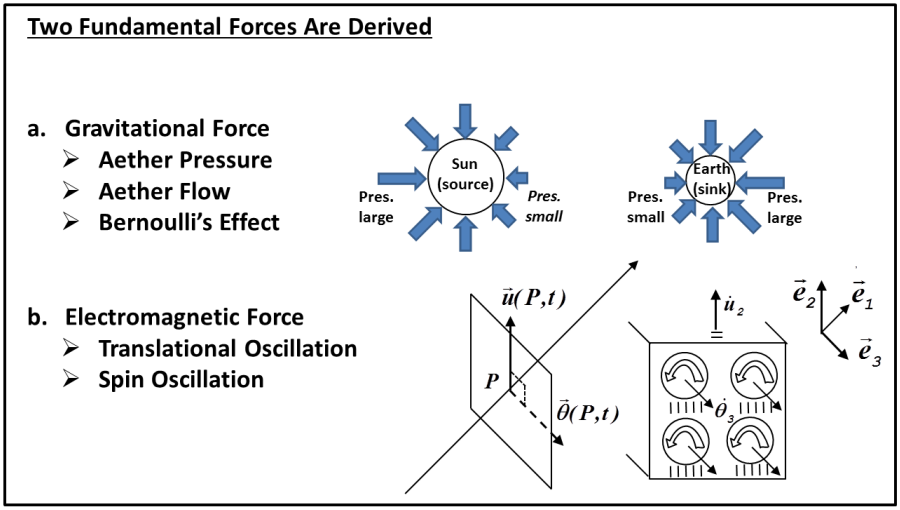
1.7 Five Properties of Substantial Aether Particles



The proposed aether theory is based on Newton's laws of motion. The whole theory is developed from solid elastic aether particles. Five properties of substantial aether particles are summarized as:

1. All aether particles have the same mass, m_a. The mass of an aether particle is very small compared to the mass of a neutron.
2. All aether particles are the same size in diameter, D_a. The size of an aether particle is also very small compared to the size of a neutron.
3. Aether particles occupy a different volume of space, V_a. Therefore aether mass density will vary in space and is defined as mass divided by volume of space occupied by a single aether particle.
4. Aether particles have colliding motion. Their translational velocity, $\vec{v}_{ca}$ is close to the speed of light. Similar to atmospheric pressure caused by gas collision motion, aether colliding motion will result in an aether pressure which will be shown to be related to many fundamental forces.
5. Aether particles also have spin motion. Their spin velocity, $\dot{\vec{\theta}}_{ca}$ is proportional to the colliding velocity. The spin velocity is very large compared to the spin velocity of gas particles. This spin motion will be shown to be related to the magnetic force.

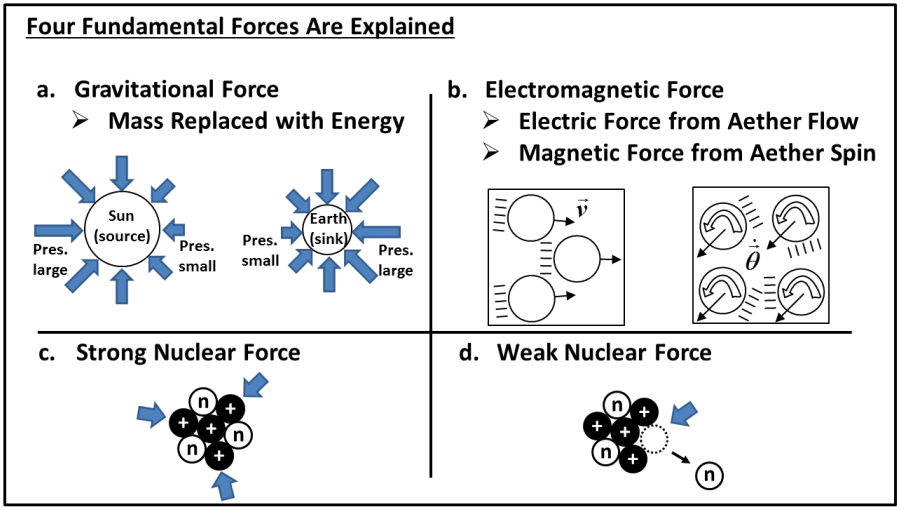
1.8 Two Fundamental Forces Are Derived



This proposed aether theory has been developed by Tsung-Wu Lin. Lin is an emeritus civil engineering professor at National Taiwan University. Since his early retirement at the age of 50 in 1993, he utilized most of his time to develop aether theory to explain fundamental forces which he strongly believes must have mechanical explanation. Lin called this aether theory Aether Mechanics because it is based on Classic Mechanics. Lin and I recently published two papers on deriving gravitational force and electromagnetic wave in the Journal of Mechanics in 2014. The derivations in these two papers are highlighted as follows:

1. Gravitational force can be calculated by integrating aether pressure force on the surface of an object such as the Earth and the Sun. If the aether pressure is constant on the surface of an object, the total pressure will be zero. The non-zero summation of pressure is due to pressure difference induced by the difference in aether flow velocity following Bernoulli's equation.
2. Electromagnetic wave is the result of translational oscillation and rotational oscillation of aether particles. The translational oscillation results in an electric wave and the rotational oscillation results in a magnetic wave. The coupling effect of translational oscillation and rotational oscillation will be discussed later.

1.9 Four Fundamental Forces Are Explained



Gravitational force and electromagnetic force are derived from Newton's laws of motion. Two other fundamental forces, strong nuclear force and weak nuclear force, will be explained in this chapter without derivation. The explanation for strong nuclear force and weak nuclear force is the inevitable conclusion from the Aether Mechanics model and is summarized as:

1. Gravitational force is the result of aether pressure difference induced by aether flow velocity difference.
2. Electric force is due to aether particles' macroscopic flow (averaged microscopic collision velocity at random directions). Magnetic force is due to aether particles' macroscopic spin (avenged microscopic spin velocity at random directions).
3. Strong nuclear force that binds positive charged protons inside a small nucleus can be explained by the aether flow.
4. Weak nuclear force that causes neutrons to escape from nucleus, known as nuclear decay, can be explained by aether pressure.

These explanations will be discussed near the end of this chapter after the gravitational force and the electromagnetic force are derived.

1.10 Five Predictions Are Concluded

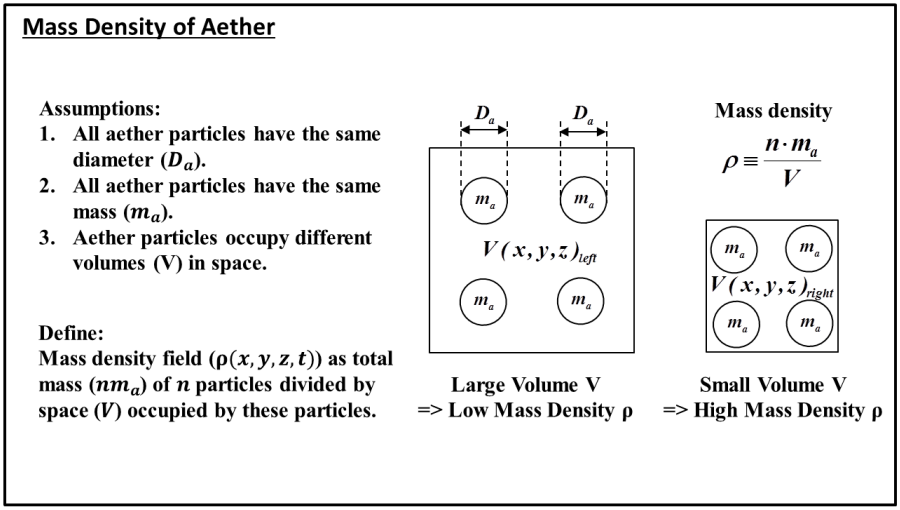
Five Predictions Are Concluded

1. **There are anti-gravitational forces between two stars.**
2. **There are anti-gravitational forces between two black holes.**
3. **A black hole is made of nucleus with an atom mass that is much heavier than U238.**
4. **A black hole can explode into a new star and a dead star can become a black hole.**
5. **Nuclear waste can be disposed by sending it toward the Sun where aether pressure is higher than at the surface of the Earth.**

Five predictions are concluded from the aether mechanics model. If the proposed aether mechanics model is correct, some of these predictions will be proven correct. If the proposed aether mechanic model is incorrect, these predictions will likely be wrong. These five predictions are summarized as:

1. There is an anti-gravitational force, or a repellent force, between two stars. Two stars represent two sources of aether. The distribution of aether flow velocity around the stars will result in this repellent force.
2. There is an anti-gravitational force, or a repellent force, between two black holes. Two black holes represent two sinks of aether. The distribution of aether flow velocity around the black holes will result in this repellent force.
3. A black hole is made of nucleus with an atom mass that is much heavier than the heaviest atom on the earth. The heaviest atom on the earth is U238.
4. A black hole can explode into a new star when the black hole is near another star. The explosion of a black hole is due to the high aether pressure around the approaching star. Further, a dead star can become a black hole.
5. Nuclear waste will decay to non-radiation materials when nuclear waste is near the sun where aether pressure is higher than at the surface of the earth.

1.11 Mass Density of Aether



Aether Mechanics assumes all aether particles are spherical balls with a diameter D_a. We do not know the exact size of an aether particle. However, we know the approximate size is very small compared to the size of a neutron.

Aether Mechanics assumes all aether particles have mass m_a. The mass of an aether particle is also very small compared to the mass of a neutron.

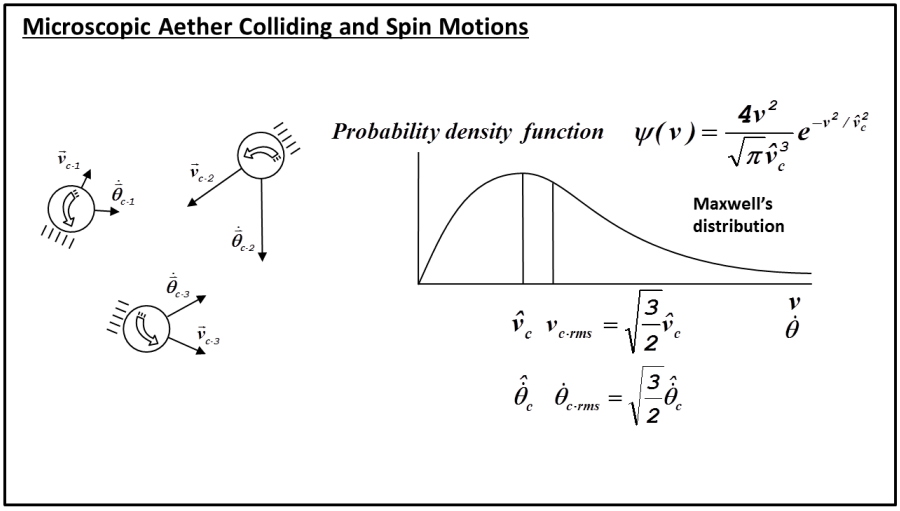
To simplify the derivation of the gravitational force and the electromagnetic force, we assume all aether particles have the same size and the same mass.

Even though aether particles have the same size and mass, the volumes they occupy in space are different. At some locations, aether particles are closer to each other. At other locations, aether particles are more distant from each other. It is important not to be confused with the size of particles and the volume it occupies.

Based on volume occupied, the mass density can be calculated by the total mass of aether particles divided by the total volume occupied. For example, the four aether particles shown on the left side of the figure above occupy a larger volume in space and have smaller mass density than the four aether particles shown on the right side of the figure that occupy a smaller volume in space.

It will be shown that lower mass density will result in lower aether pressure and higher mass density will result in higher aether pressure.

1.12 Microscopic Aether Colliding and Spin Motions



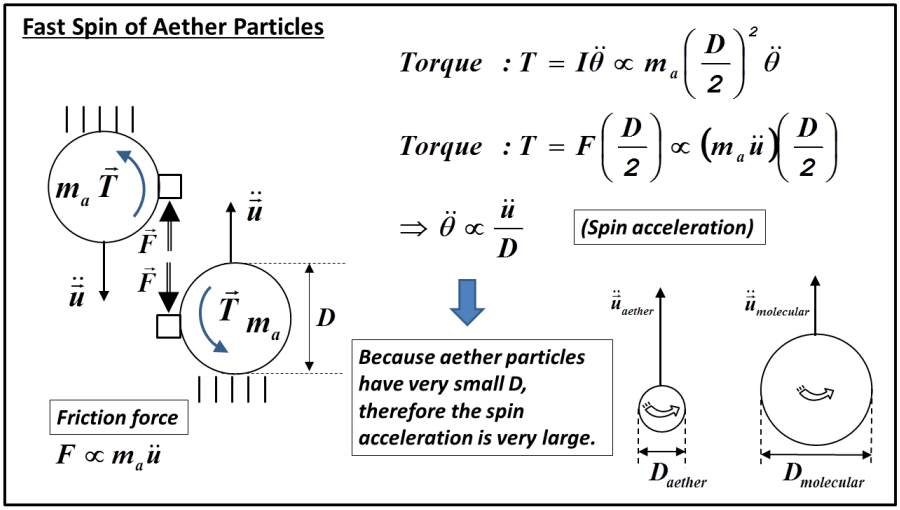
When we zoom in to see the microscopic motion of aether particles, we should see both colliding motion and spin motion:

1. Aether particles' colliding motion:
   Aether particles' microscopic colliding motion is translational movement that results in the colliding of particles. Aether particles' colliding motion is very similar to the colliding motion of the gas particles. These translational colliding velocities can be represented by vectors: $\vec{v}_{c1}, \vec{v}_{c2}$ and $\vec{v}_{c3}$. The directions of colliding velocity vectors are random in space. The magnitudes of colliding velocity vectors are random but follow Maxwell's distribution.
2. Aether particles' spin motion:
   Aether particles' microscopic spin motion is self-spinning motion of aether particles. These rotational spin velocities can be represented by vectors: $\dot{\vec{\theta}}_{c1}, \dot{\vec{\theta}}_{c2}$ and $\dot{\vec{\theta}}_{c3}$. The directions of spin velocity vectors are random in space. The magnitudes of spin velocity vectors are also random but follow Maxwell's distribution.

Magnitudes of both colliding velocity and spin velocity follow Maxwell's distribution. Maxwell's distribution is the final steady state result of a bunch of particles colliding with each other starting with any arbitrary initial condition.

The spin motion of gas particles are usually neglected when deriving the ideal gas law because gas particles do not rotate very fast. However, spin motion of aether particles is as important as colliding motion when deriving electromagnetic force because the spin motion of aether particles is very fast.

1.13 Fast Spin of Aether Particles

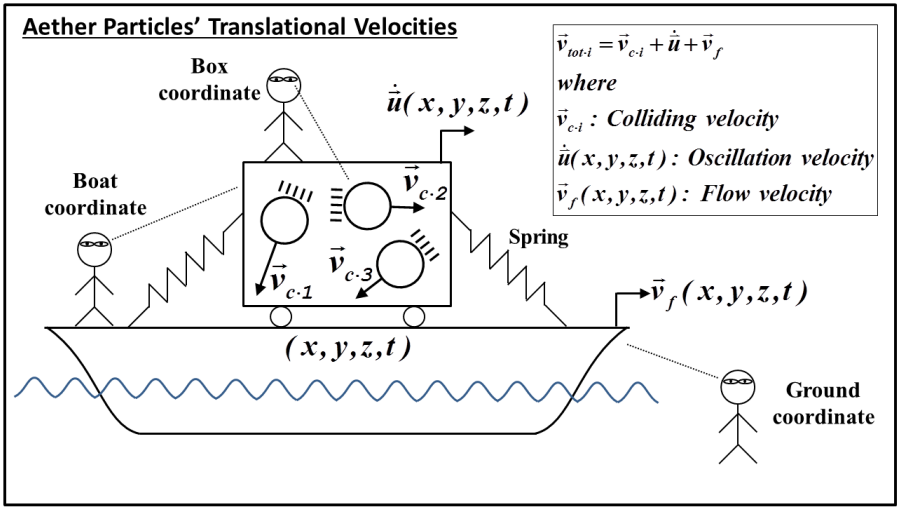


Aether mechanics assumes aether particles spin at a very fast speed. Electromagnetic wave is derived based on both fast colliding motion and fast spin motion. So, does it makes sense that tiny aether particles can spin at a very fast speed? The answer of course is yes. It can be explained by Newton's laws of motion.

When two particles, as shown on the left, are moving toward each other at the same magnitude and opposite direction, it is assumed that the two particles are colliding with a friction force. Friction forces will act on the surfaces of the particles. The exact magnitude of friction force F is related to the roughness of the surface of aether particles and the colliding angle. It is reasonable to conclude that the magnitude of the force is proportional to the mass times the acceleration of the particle.

The friction force F on the surface of the particle will result in a torque T to this particle. This torque will result in a rotational angular acceleration of the particle following Newton's 2nd law of motion where: torque is equal to the moment of inertia times the angular acceleration. The moment of inertia of a spherical ball is proportional to mD^2. Therefore, it can be concluded that the angular acceleration is proportional to the colliding acceleration but inversely proportional to the diameter of the particle. Because aether particles have a very small diameter, therefore, the spin acceleration is very large.

1.14 Aether Particles' Translational Velocities



In order to explain the aether particle translational motion, an example is used to show the definition of three translational velocities.

In the example, three aether particles move randomly in a rectangular box. The box is attached to a boat with two springs. Because of these two springs, the box can oscillate forward and backward on the boat. Finally the boat floats on water.

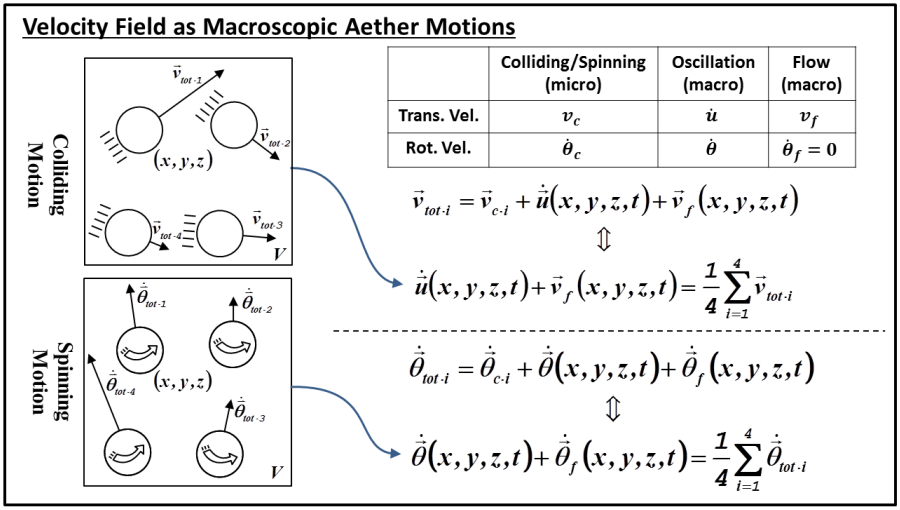
When we want to study the kinetic action of the particles, we do not want to consider the motion of the box nor the boat. Therefore, particle colliding velocity is best defined from the box coordinate which is in oscillation on the boat.

When we want to study the vibration of the box, we do not want to consider the motion of the particles nor the boat. Therefore, box velocity is best defined from the boat coordinate.

When we want to study the flow velocity of the boat, we do not want to consider the motion of the particles nor the box. Therefore, boat velocity is best defined from the ground coordinate.

We can superpose (1) colliding velocity, (2) oscillation velocity and (3) flow velocity into a global (total) velocity of an aether particle. Note that this total velocity refers to an aether particle and is not a function of location.

1.15 Velocity Field as Macroscopic Aether Motions



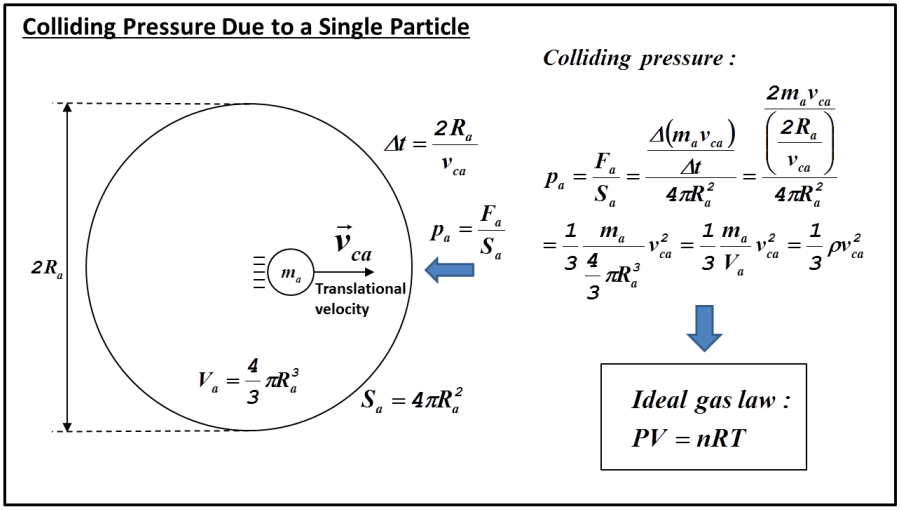
In the previous example, microscopic colliding velocity of particles can be defined as (1) $\vec{v}_c$ from the box coordinate or (2) $\vec{v}_{tot}$ from the global coordinate. Both describe the same microscopic colliding velocities of an aether particle but from two different coordinate systems. Total velocities of colliding and spin motions observed from the global coordinate are shown in the figure. Note that both $\vec{v}_{c.i}$ and $\vec{v}_{tot.i}$ refer to an individual particle.

For the purpose of studying the aether particle oscillation and flow, the averaged motion is defined by taking the average velocity of all particles in the volume V at location (x, y, z) and at time (t). By taking the average, the result of the velocity becomes a field of function of (x, y, z) and (t) and no longer refers to an individual particle.

In the first equation, the translational total velocity of an aether particle is observed from the global coordinate and is defined by adding colliding, oscillation and flow velocities. The second equation reverses the definition and uses total velocity to define oscillation and flow velocities. These definitions are provided here in order to demonstrate the relationship between these three velocities.

Following the same manner, spin motion of an aether particle can also be observed from three different coordinates and is listed in the table for comparison to the colliding motion. Note that the rotational flow velocity is zero. Otherwise, a steady magnetic field would exist. Also note that the vortex motion comes from the curl of $\dot{\vec{u}}$ and $\vec{v}_f$ but not the spin motion of aether particles.

1.16 Colliding Pressure Due to a Single Particle



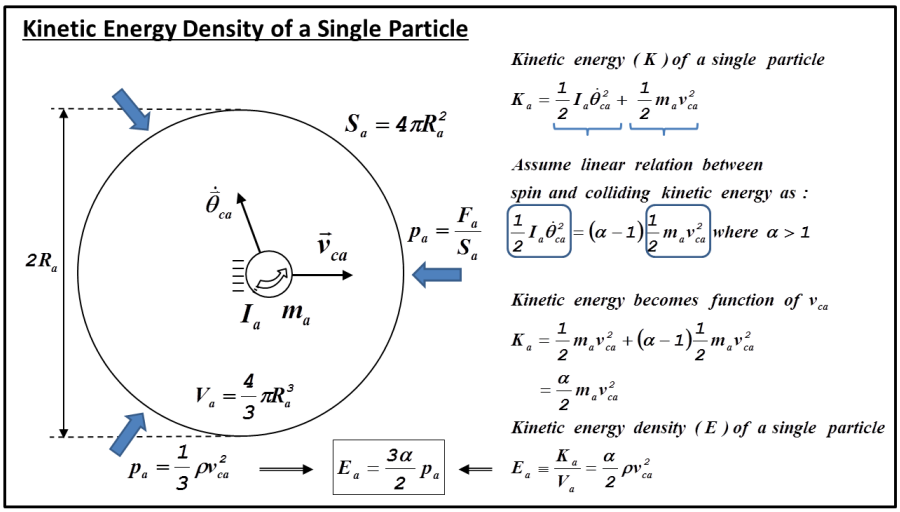
Pressure is defined by force per unit area. Air pressure comes from impact forces due to the colliding velocity of gas particles with mass. When gas particles collide into a surrounding object, the momentum changes before and after the collision which will result in a force on the colliding particles. The particles are made of molecules such as O_2, N_2 , CO_2 or H_2O.

Following the same procedure for calculating air pressure, aether pressure from a single aether particle can be calculated as follows:

Assume a single particle with mass m_a is moving at the longest distance inside of a perfect spherical ball with a radius R_a. The pressure on the surface of the spherical ball can be calculated by the force divided by the surface area of the ball $4\pi R_a^2$. The force due to collision is the momentum change $2m_a v_{ca}$ divided by the time it takes for the particle to travel from one wall to the other wall along the diameter $\Delta t = \frac{2R_a}{v_{ca}}$. Note that, the density is $\rho = \frac{m_a}{V_a}$ and the volume is $V_a = \frac{4}{3}\pi R_a^3$. We get pressure $p = \frac{1}{3}\frac{m_a}{V_a} v_{ca}^2$ or $p = \frac{1}{3}\rho v_{ca}^2$.

Because calculating aether pressure is similar to calculating air pressure, the derived equation $p = \frac{1}{3}\rho v_{ca}^2$, can be further transformed into the famous ideal gas law $PV = nRT$, by relating particle velocity v_{ca} to temperature T. However, temperature is not used in aether mechanics because aether energy is much higher than the energy related to the temperature due to gas collision. Therefore, the original form of pressure $p = \frac{1}{3}\rho v_{ca}^2$ is used in aether mechanics.

1.17 Kinetic Energy Density of a Single Particle



In classical mechanics, kinetic energy includes both translational and rotational kinetic energy. Translational kinetic energy is half of the mass multiplied by the square of velocity. Rotational kinetic energy is half of the moment of inertia multiplied by the square of spin velocity.

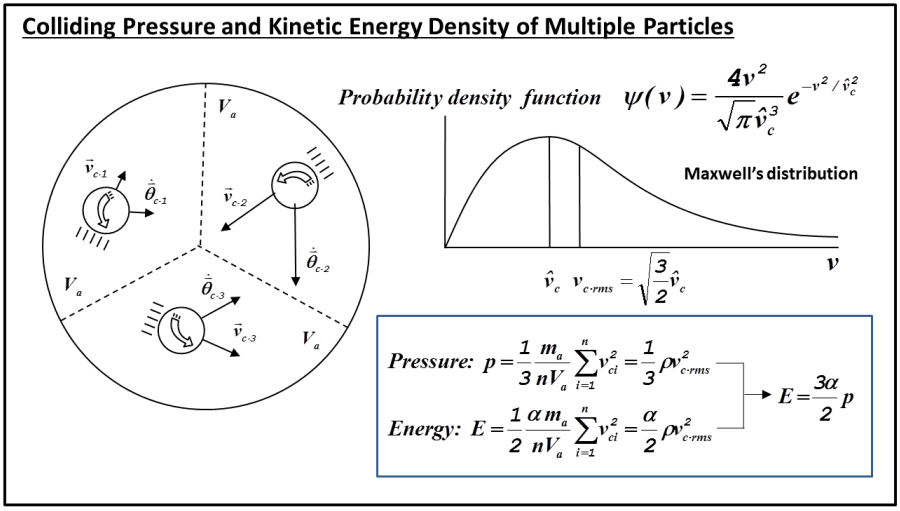
As we mentioned before, aether particles have both translational colliding motion and spin motion. Both colliding motion and spin motion are important in deriving gravitational force and electromagnetic force. Therefore, the kinetic energy of an aether particle is written as $K_a = \frac{1}{2} I_a \dot{\theta}_{ca}^2 + \frac{1}{2} m_a v_{ca}^2$.

Because spin velocity is induced by translational velocity, it is reasonable to assume a linear relationship between translational kinetic energy and spin kinetic energy by a coefficient of $(\alpha - 1)$, where $(\alpha - 1) > 0$. Based on this argument, kinetic energy can be written with a translational energy term using a constant coefficient α.

Kinetic energy density is defined by total kinetic energy per unit of volume. Kinetic energy density can be calculated by dividing total kinetic energy $\frac{\alpha}{2} m_a v_{ca}^2$ by the volume of the spherical ball V_a. We can rearrange terms to get kinetic energy density $E_a = \frac{\alpha}{2}\rho v_{ca}^2$.

Finally, a simple relationship between pressure and kinetic energy density can be concluded by comparing pressure $p_a = \frac{1}{3}\rho v_{ca}^2$ and kinetic energy density $E_a = \frac{\alpha}{2}\rho v_{ca}^2$. The equation which relates pressure to energy density is $E_a = \frac{3\alpha}{2} p_a$.

1.18 Colliding Pressure and Kinetic Energy Density of Multiple Particles



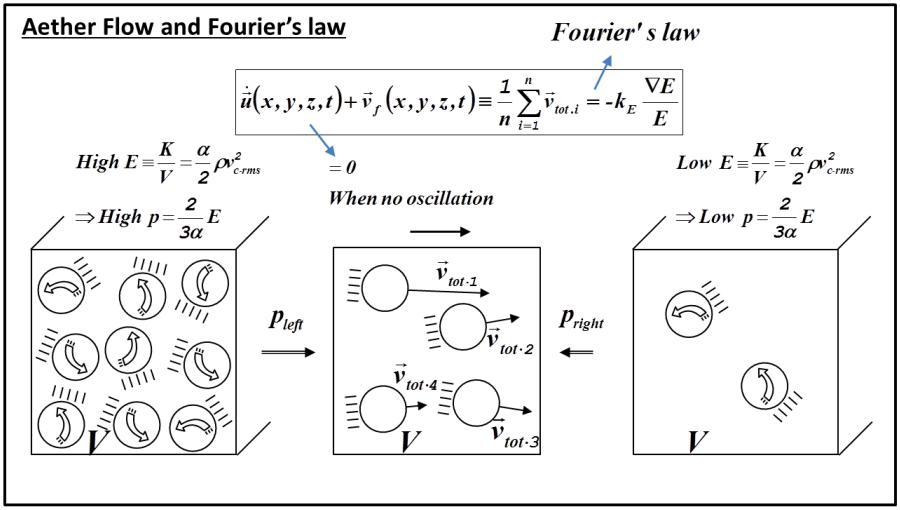
Aether pressure and kinetic energy density of a single aether particle are derived by assuming the particle is moving at a constant speed. In reality, the speed of perfect elastic particles will reach Maxwell's distribution after colliding with surrounding particles. Therefore, the translational speed of both gas particles and aether particles should be Maxwell's distribution. In Maxwell's distribution, the Root-Mean-Square (RMS) speed is related to the most probable speed $\hat{v}_c$ as $v_{rms}=\sqrt{\frac{3}{2}}\hat{v}_c$.

Note that aether pressure of multiple particles can be calculated by the mean pressure $p=\frac{1}{3}\rho v^2$. Because pressure is directly related to the square of colliding speed, the RMS speed is used to replace the speed of a single particle.

Similar to aether pressure, aether energy density of multiple particles can also be calculated by the mean kinetic energy density of aether particles. Aether kinetic energy density is very large because aether pressure is very high compared to air pressure. Aether mechanics assume the universe is made of only two types of particles: aether particles and neutron particles. The neutron particles have little energy. Most of the energy of the universe is stored in aether kinetic energy.

By comparing pressure and energy density, the previous simple relationship between pressure and energy density remains the same: $E=\frac{3\alpha}{2}p$. Even though the most probable speed and the RMS speed can be used to express pressure and energy density, the RMS speed of aether particles is used in developing the theory.

1.19 Aether Flow and Fourier's Law



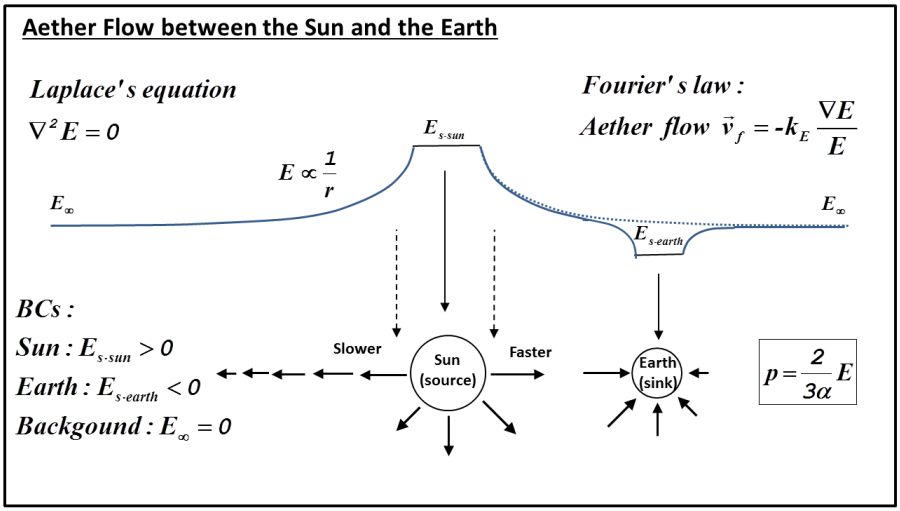
Similar to gas particles, aether particles flow from higher pressure locations to lower pressure locations. For example, some aether particles are located between high pressure on the left-hand side and low pressure on the right-hand side. The left-hand side will have higher pressure than the right-hand side. The resulting pressure difference will force these particles in between to flow from left to right.

Aether pressure is related to energy density. And, energy density is directly proportional to mass density and the RMS speed square. Since the RMS speed is nearly constant, the difference of pressure is mainly due to the difference of the mass density. For the given example, the left-hand side with higher pressure has higher mass density than the right-hand side.

It is important not to be confused between flowing velocity and colliding velocity. The pressure is due to colliding velocity which is close to the speed of light. The pressure difference causes these particles to flow. These flowing particles have both microscopic colliding velocity and macroscopic flowing velocity. As mentioned before, the flowing velocity is observed from the global coordinate and colliding velocity is observed from the boat coordinate. The colliding velocity is much larger than the flowing velocity.

The aether flowing velocity is a steady state macroscopic velocity. The macroscopic flowing velocity can be calculated by taking the average of the microscopic total velocity observed from the global coordinate. The total velocity includes the microscopic motion of colliding and the macroscopic motions of oscillation and flowing. Note that what is discussed here is under the condition that aether macroscopic oscillation does not occur.

1.20 Aether Flow between the Sun and the Earth



Aether particles flow from high pressure locations to low pressure locations. The pressure is due to the impact force from the colliding of particles. Aether pressure is directly related to aether kinetic energy as shown. Based on Fourier's law, aether flow can be related to the gradient of energy density as shown. Therefore, if we know aether energy density E, we can know aether particle flow velocity v_f.

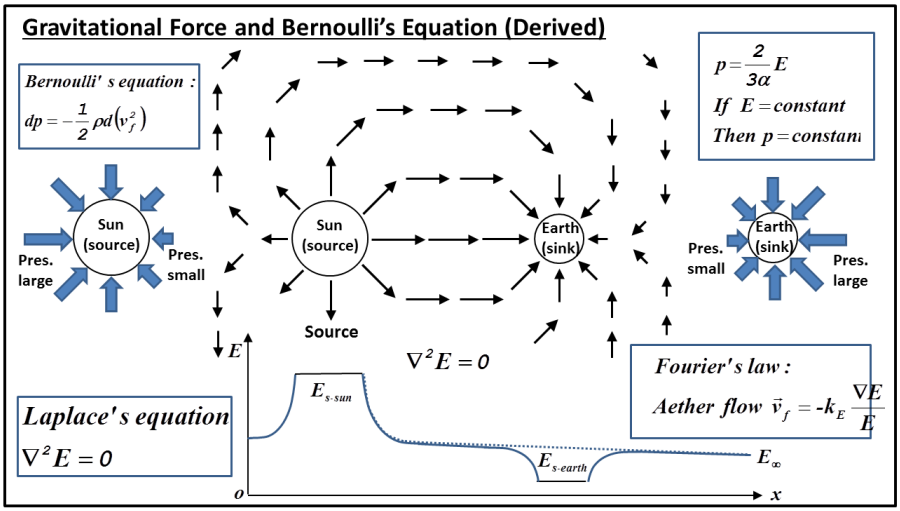
The energy density field E can be calculated from Laplace's equation. Laplace's equation of energy density can be derived from the conservation of energy and Fourier's law. The derivation of Laplace's equation of energy density is shown in detail in chapter 3.

In the Sun-Earth system as shown, the boundary conditions required for solving the Laplace's equation are (1) a constant high energy density on the surface of the Sun, (2) a low background energy density at a distance far away from the Sun and the Earth, and (3) another constant energy density on the surface of the Earth.

The energy density outside the surface of the Sun has an energy density distribution similar to the $\frac{1}{r}$ curve on the left-hand side of the Sun. The energy density near the Earth due to only the Sun's and background's energy density is represented by a dotted curve line on the right-hand side of the Sun assuming that Earth does not exist in the space.

When the Earth is placed in the system, because the Earth has a lower energy density than the surrounding energy density represented by the dotted line, the Earth behaves like a sink and the aether flows into the Earth from its surrounding area. Aether flows faster on the left-hand side than on the right-hand side because the energy gradient on the left-hand side is higher.

1.21 Gravitational Force and Bernoulli's Equation



Gravitational force will be shown to be the result of the difference of aether flow velocity around an object. The detailed derivations of them are provided in chapters 2 to 7.

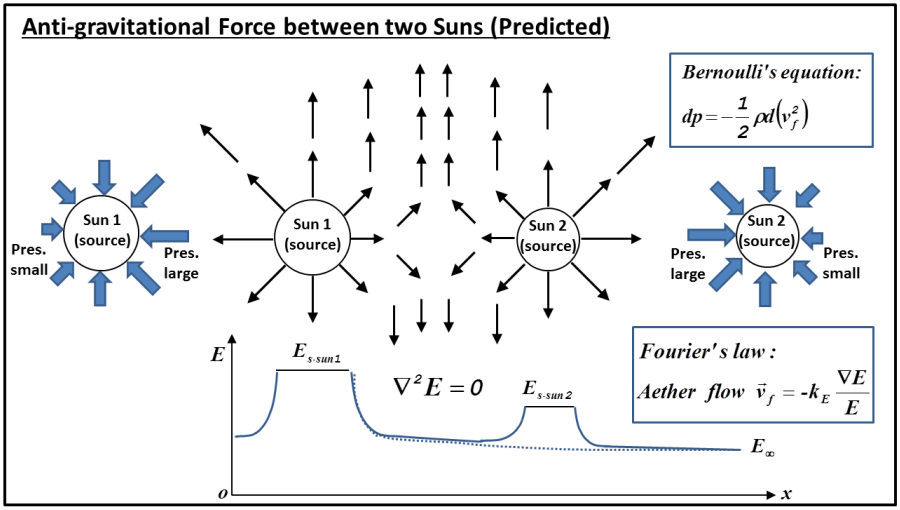
Gravitational force will be zero if there is no difference of aether flow velocity around an object. In the Sun-Earth example, the energy density E is constant on the surface of the Earth. Therefore, the pressure on the surface of the Earth is also constant. The resulting force of the summation pressure on the surface of the Earth will be zero.

Gravitational force will not be zero if there is difference of aether flow velocity around the surface of the Earth. The aether flow velocity can be calculated from the gradient of the energy density following Fourier's law. The energy density curve of the Sun-Earth system is shown to demonstrate how the flow velocity is related to the gradient of the energy density along a line passing through the Sun and the Earth.

On the surface of the Earth, the left-hand side of the Earth has a larger gradient of the energy density than the right-hand side does. According to Fourier's law, the left-hand side of the Earth has a faster aether flow velocity than the right-hand side does. According to Bernoulli's equation, the left-hand side of the Earth will have a smaller aether pressure, due to a larger pressure reduction from faster aether flow.

Gravitational force is shown to be the summation of the aether pressure on the surface of the earth. However, the derived gravitation is not exactly the same as Newton's gravitation. The masses of objects in Newton's gravitation are replaced by energy densities on the surfaces of the objects. This makes sense because mass cannot provide force in mechanics but energy does.

1.22 Anti-gravitational Force between two Suns



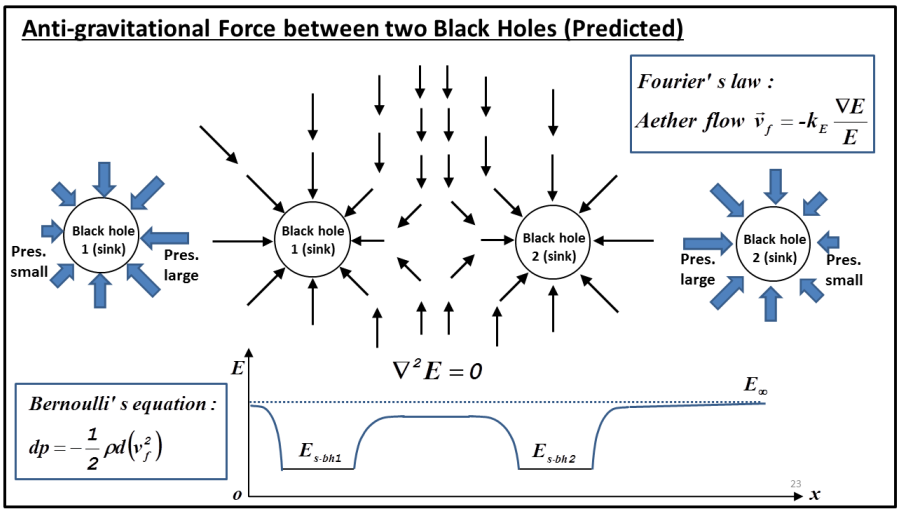
The first prediction is that there are anti-gravitational forces between two suns. In other words, there are repellent forces between two suns.

In a sun-sun system as shown, two suns are placed at a distance to each other. Let's say the sun-1 on the left-hand side is the same sun in our Sun-Earth system. The sun-2 on the right-hand side is defined as a sun, or source, because its energy density is higher than the surrounding energy density (shown as a dotted line) due to the sun-1 alone. If the energy density of the sun-2 is lower than the surrounding energy density due to the sun-1, there will be a sink of aether flow similar to our Earth.

The energy density and the gradient of the energy density along a line passing through these two suns are shown to indicate the direction and magnitude of aether flow in one dimension. It is then extended to two dimensions to show aether flow around these two suns.

In the sun-sun system, aether flows out of these suns. Because the gradient of the energy density is smaller on the left-hand side of the sun-2, aether flows slower on the left-hand side of the sun-2. According to Bernoulli's equation, aether pressure is larger on the left-hand side of the sun-2 than on the right-hand side of the sun-2. The summation of all pressure forces on the sun-2 will force it to move away from the sun-1. It is a repellent force and is opposite to what will be naturally assumed.

1.23 Anti-gravitational Force between two Black Holes



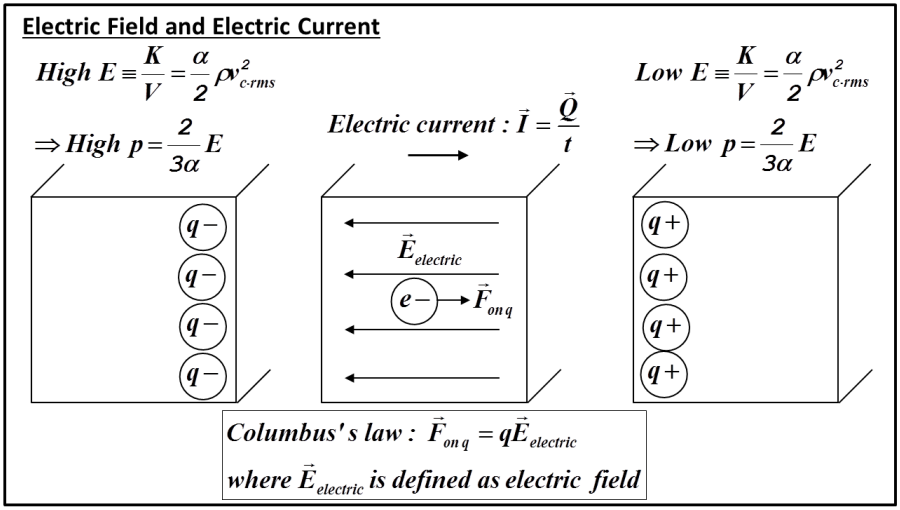
The second prediction is that there are anti-gravitational forces between two black holes. In other words, there are repellent forces between two Black Holes (BHs).

In a BH-BH system as shown, two BHs are placed at a distance to each other. The dotted line represents energy density field due to only the BH1 shown on the left-hand side of the figure. The BH2 on the right-hand side is defined as a BH, or sink, because its energy density is lower than the surrounding energy density due to the BH1 alone. If the energy density of the BH2 is higher than the surrounding density due to the left-hand side BH1, it will be a source, not a sink, at this particular location.

The energy density and the gradient of the energy density along a line passing through these two BHs are shown to indicate the direction and magnitude of aether flow in one dimension. It is then extended to two dimensions to show aether flow around these two BHs.

In the BH-BH system, aether flows into these BHs. Because the gradient of the energy density is smaller on the left-hand side of the BH2, aether flows slower on the left-hand side of the BH2. According to Bernoulli's equation, aether pressure is larger on the left-hand side of the BH2 than at the right-hand side of the BH2. The summation of all pressure forces on the BH2 will force it to move away from the BH1. It is a repellent force and is opposite to what will be naturally assumed.

1.24 Electric Field and Electric Current



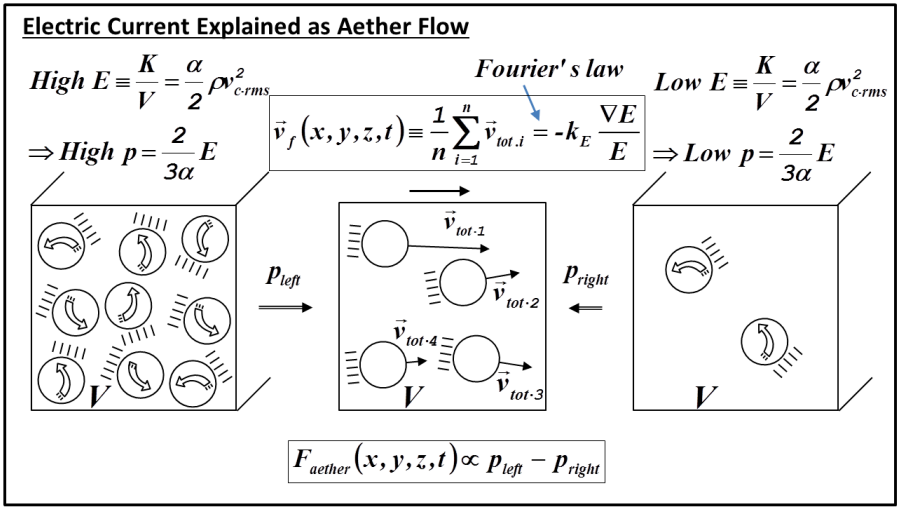
Electric field $\vec{E}$ is defined in Columbus's law. Electric field is defined as force acting on a unit of electric positive charge placed in an electric field. For example, an electric field exists between two different electric charges. In the example shown, there are negative electric charges on the left-hand side and positive electric charges on the right-hand side. The electric field can be represented by the vectors that point to the left.

The electric field can be tested by placing a negative electric charge in the electric field. In the example, a negative electric charge is placed in the electric field. Because the electric charge is negative, the force on this negative electric charge will point to the right which is opposite to the electric field.

The force on the electric charge will make the electric charge move. In the example, the negative electric charge will be forced to move to the right due to the positive charges on the right-hand side and the negative charges on the left-hand side. The amount of electric charges moving through a cross section per unit of time is defined as electric current.

What is mentioned here is based on the conventional knowledge of electric force. Electric force is one of four fundamental forces and is considered as a non-contact force. The cause of the electric force on the electric charge is usually left without explanation.

1.25 Electric Current Explained as Aether Flow



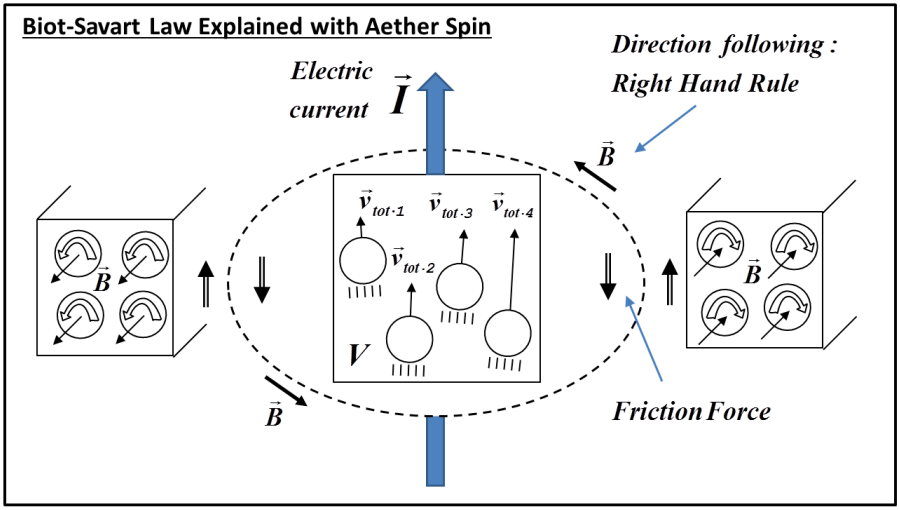
Aether mechanics provides a mechanical explanation to electric force based on the proposed assumption of colliding and spin motions of the aether particles.

In aether mechanics, electric current is aether particle flow. Aether particles flow from a higher aether pressure location toward a lower aether pressure location as shown in the figure. Because pressure is directly related to energy density, aether flows from a higher energy density location to a lower energy density location.

Aether macroscopic flow and aether microscopic colliding motion are different. Aether colliding motion causes the aether pressure. Aether colliding velocity is referred to an individual aether particle and is observed from the box coordinate. On the other hand, aether flow causes electric current. Aether flow velocity is referred to an averaged total velocity at the location.

It might sound too strange to explain electric flow with aether flow because we cannot detect electric flow as the flow of aether particles. But, this explanation actually removes the concept of electric charge from the electric force because aether particles do not carry any electric charge. This will become clear when electromagnetic force is explained later in this chapter.

1.26 Biot-Savart Law Explained with Aether Spin



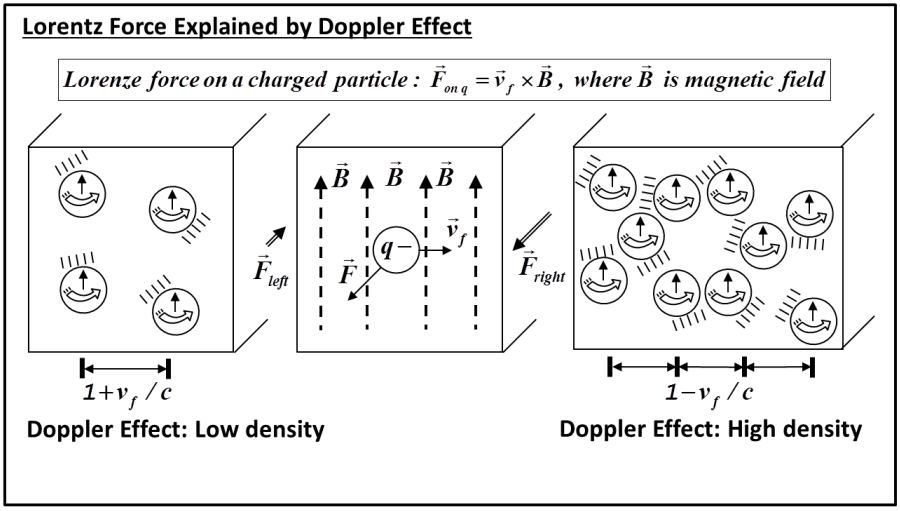
Biot-Savart law describes the magnetic field generated by an electric current. For example, an electric wire is placed upright as an electric current moves upward. Based on Biot-Savart law, this current will generate a magnetic field around this electric current. The direction of magnetic field $\vec{B}$ is perpendicular to the current direction and follows the right-hand rule as shown. This magnetic field caused by the electric current can also be explained by Aether mechanics as follows.

Aether particles flow upward along the electric wire because electric current is nothing more than aether flow. This flow of aether particles will generate friction force on the surrounding aether particles. The friction forces are in the same direction of the aether flow or the electric current. The friction forces will cause the surrounding aether particles to spin in the direction perpendicular to the aether flow direction (following the right-hand rule as shown) and result in an average spin velocity in that direction. The force that can cause aether particles to spin is the so-called magnetic field.

In the example, aether particles on the left-hand side of the electric current have an upward friction force on the right-hand side surface. This upward friction force can cause aether particles to spin in an outward direction. The direction of the spin is the same as the direction of the magnetic field described by Biot-Savart law at this location.

Aether spin is partially caused by the friction force due to aether flow. Aether particles spin everywhere in the universe due to aether colliding motion. Since the spin vector is uniformly distributed in any direction, the average spin velocity is zero.

1.27 Lorentz Force Explained by Doppler Effect

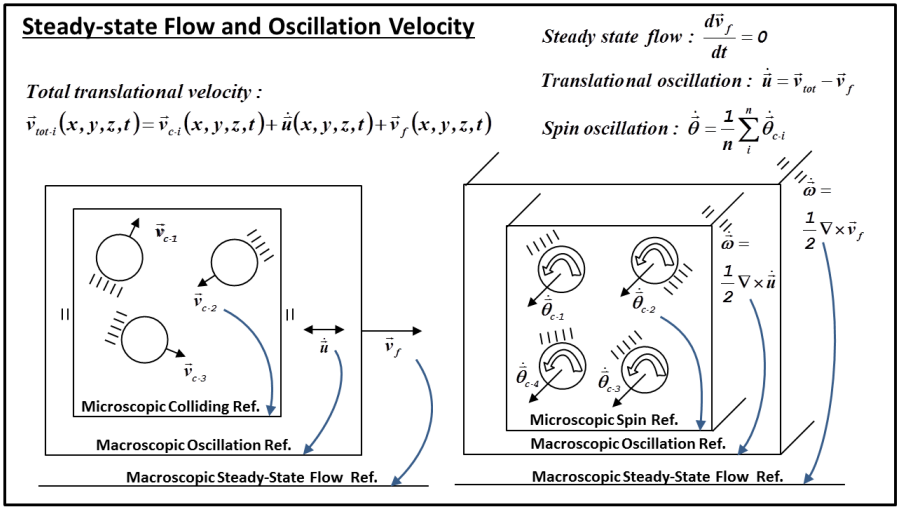


Electric field is tested by placing an electric charge in the electric field to measure the force acting on the electric charge. Magnetic field is tested by placing a MOVING electric charge in the magnetic field to measure the force acting on the electric charge. The direction of the force acting on a moving electric charge in the magnetic field is perpendicular to the direction of the magnetic field and the direction of movement. This force is called Lorentz force. Aether mechanics can explain Lorentz force using the Doppler effect as follows.

Aether particles spin uniformly in a uniform magnetic field. When an aether particle is moving from left to right, the aether particles in front of the moving particle will be squeezed into a higher mass density condition. As a result, there will be more spin aether particles per unit volume in front of the moving particle as shown. Therefore the total friction force due to aether spin will be greater in front of the moving particle than from behind. This resulting force is the Lorenz force.

The Doppler effect causes a higher mass density in front of a moving aether particle and is similar to higher air mass density in front of a high speed air plane. Only in relation to translational motion do aether particles behave in a similar manner to air gas particles.

1.28 Steady-state Flow and Oscillation Velocity

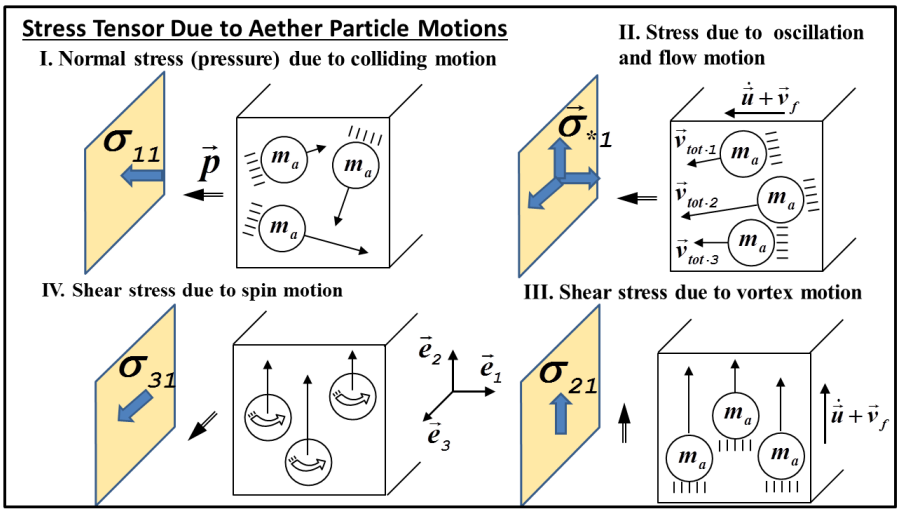


For steady state flow we consider only translational motion of aether particles. Such translational motion is described for different purposes of analysis and is observed from different coordinates. Microscopic colliding motion is used for analyzing aether pressure and kinetic energy density. Microscopic colliding motion is observed from the reference coordinate that moves along the oscillation motion. The oscillation motion is used for analyzing electromagnetic wave oscillation. Such oscillation motion is observed from the reference coordinate that moves along the flow motion. Finally, the flow motion is utilized for analyzing the aether flow that causes the gravitational force and is observed from the fixed global coordinate.

Steady state flow is used to describe the time independent of flowing velocity for calculating gravitational force. The time derivative of steady state flow velocity is zero. In fact, when the time dependent oscillation part of the motion is removed and only the time independent steady state motion is kept, steady state flow velocity describes the same averaged translational motion. Spin motions of aether particles is a little different from translational motion. There is no steady state spin velocity if no steady state magnetic field exists. Spin oscillation is formulated as the average spin velocity of a group of aether particles. Vortex motion is only related to the translational motion and can be calculated by the curl of the aether translational motion.

The translational and spin oscillations contain no steady state flow information because they are observed from the steady state flow coordinate. The translational and spin oscillations are time dependent and are used to analyze the electromagnetic wave.

1.29 Stress Tensor Due to Aether Particle Motions

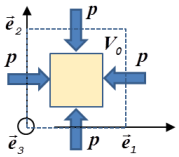


The same electromagnetic wave from Maxwell's equations are obtained from the equation of motion of aether medium. The equation of motion of aether medium comes from the stress-strain relations of aether medium. The stress induced by aether motion can be categorized into four types:

1. Normal stress due to aether particles microscopically colliding: The normal stress caused by aether particles colliding is hydrostatic pressure. On average, it is a steady state pressure and can be neglected in the study of electromagnetic wave.
2. Stress due to aether averaged oscillation and flow motions: Stress can be caused by aether averaged translational motion which includes oscillation and flow motions. Aether flow is a steady state motion and can be neglected in the study of electromagnetic wave.
3. Shear stress due to aether vortex motion: Shear stress can be caused by the same motion that causes stress in item 2. Vortex motion is the curl of $\dot{\vec{u}}+\vec{v}_f$ and comes from translational oscillation and flow motions. The vortex from flow motion is a steady state motion and can be neglected in the study of electromagnetic wave.
4. Shear stress due to averaged aether spin motion: Shear stress can be induced by the averaged spin motion of aether particles. Spin motion refers to an individual aether particle as it spins about its center. If the average spin motion is zero, aether particles spin in a random direction and cause no shear stress. When aether particles spin in the same direction, they will induce shear stress.

1.30 Dilation Strain and Deviation Strain

Dilation Strain and Deviation Strain

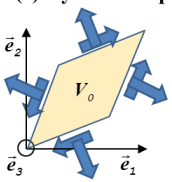


$$\begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} = K\left(\varepsilon_{11}+\varepsilon_{22}+\varepsilon_{33}\right)\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

where $\sigma_{12}=\sigma_{21}=\sigma_{13}=\sigma_{31}=\sigma_{23}=\sigma_{32}=0$

and K is bulk modulus (empirical constant)

(a) Hydrostatic pressure due to dilation strain – Volume change; Angle the same



$$\begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} = 2\mu\left[\begin{bmatrix} \varepsilon_{11} & \varepsilon_{12} & \varepsilon_{13} \\ \varepsilon_{21} & \varepsilon_{22} & \varepsilon_{23} \\ \varepsilon_{31} & \varepsilon_{32} & \varepsilon_{33} \end{bmatrix} - \frac{1}{3}\left(\varepsilon_{11}+\varepsilon_{22}+\varepsilon_{33}\right)\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}\right]$$

where $\sigma_{11}+\sigma_{22}+\sigma_{33}=0 \Rightarrow$ *Volume no change*

and 2μ *is shear modulus (empirical constant)*

(b) Stress due to deviation strain – Angle change; Volume the same

In continuum mechanics, stress and strain are usually related in a linear fashion with two moduli: bulk modulus and shear modulus.

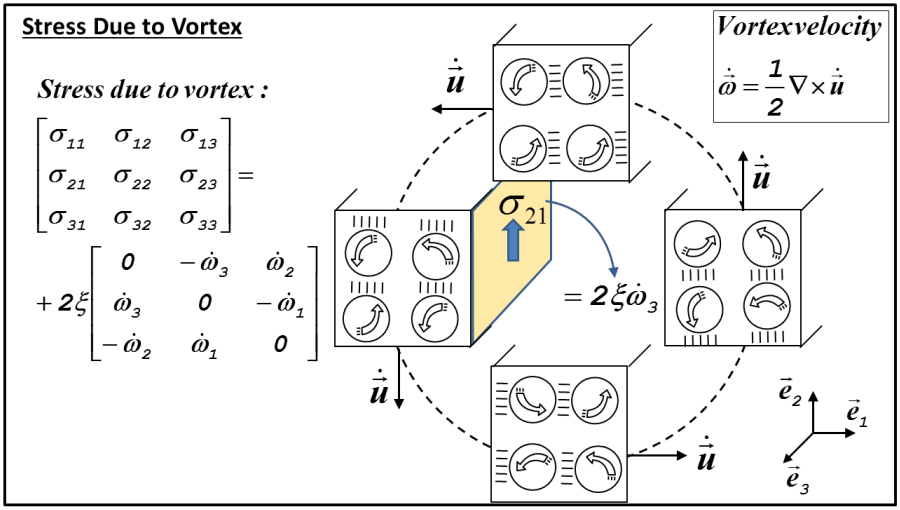
Bulk modulus is used to connect hydrostatic pressure and dilation strain. Dilation strain is a special strain that describes a volume deformation with only a volume change and without a twist (angle change). Because hydrostatic pressure has the same normal stress in all directions, it will cause only a volume change without changing the shape of the imaginary volume.

The dilation strain tensor is one-third of the summation of $\epsilon_{11}, \epsilon_{22}$ and ϵ_{33} multiplied by a unit matrix. Dilation strain can be related to stress tensor with bulk modulus K that is an empirical constant from measurement.

Shear modulus is used to connect shear stress and deviation strain. Deviation strain is also a special strain that describes a volume deformation with only a twist (angle change) and without a volume change. Deviation strain can be obtained by subtracting dilation strain from deformation strain.

Note that the summation of the diagonal terms of the deviation strain is zero. Because the sum of the diagonal terms is zero, there is no volume change for the deviation strain. The non-zero off-diagonal terms represent angle change between two intersections and can be related to stress with empirical shear modulus.

1.31 Stress Due to Vortex



$$\begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} = + 2\xi \begin{bmatrix} 0 & -\dot{\omega}_3 & \dot{\omega}_2 \\ \dot{\omega}_3 & 0 & -\dot{\omega}_1 \\ -\dot{\omega}_2 & \dot{\omega}_1 & 0 \end{bmatrix}$$

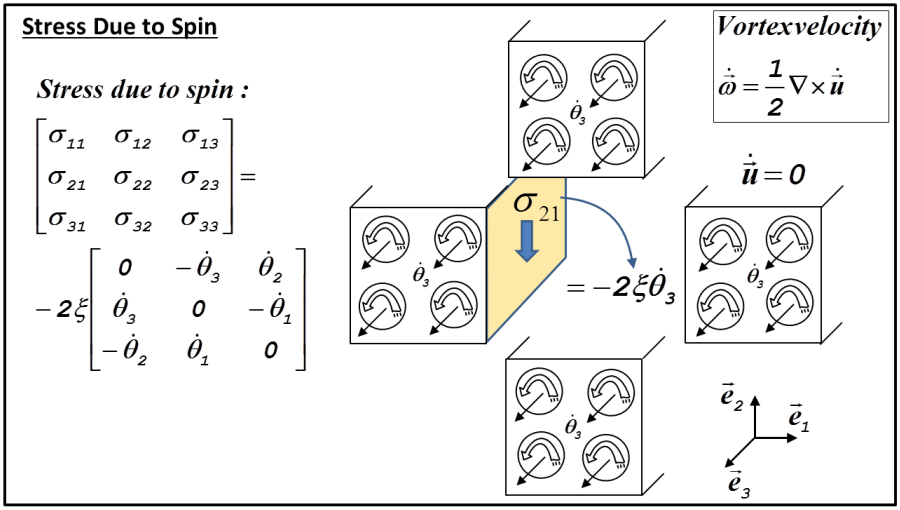
There are four types of strain used in the constitution equation for deriving equation of motion of aether medium. Besides the previously mentioned dilation and deviation strains, there is also vortex strain and spin strain. The vortex strain and its relationship with stress will be discussed.

Vortex motion is due to aether translational motion. Note that aether flow can also cause vortex motion but it is a steady state motion and can be neglected for deriving electromagnetic wave equations. Vortex angular velocity is calculated as the curl of translational velocity $\dot{\vec{u}}$.

In the example shown, aether particles move counterclockwise with a velocity $\dot{\vec{u}}$ as shown in the figure. The counterclockwise current of $\dot{\vec{u}}$ will create a vortex with vortex velocity $\dot{\vec{\omega}} = \frac{1}{2}\nabla \times \dot{\vec{u}}$. A surface on the right-hand side surface of the left-hand side cube will have a stress due to friction force. Because the aether in the left-hand side cube is moving downward relative to the fixed aether at the vortex center, it will create an upward shear stress on the right-hand side surface of the cube.

Vortex tensor can be related to the stress tensor in a matrix format through a simple empirical constant ξ. The vortex velocity and stress should have a linear relationship because friction force is often directly related to relative velocity between objects.

1.32 Stress Due to Spin



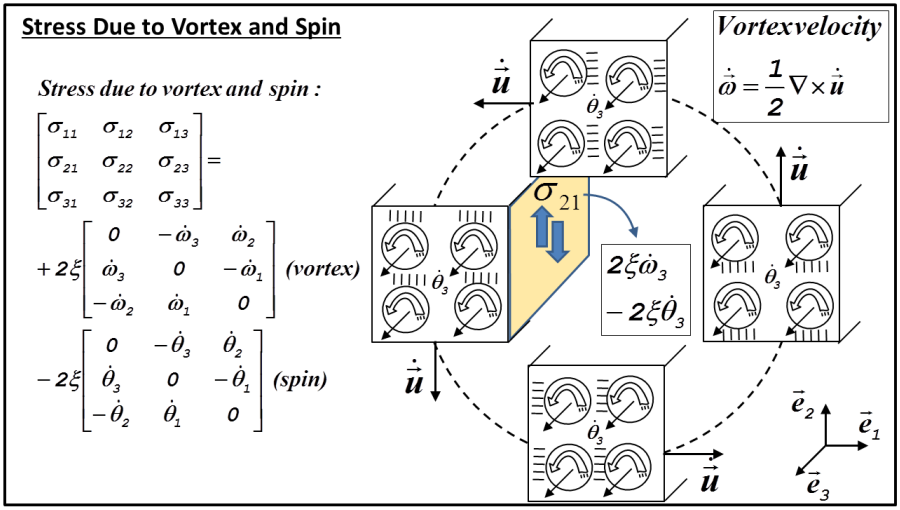
$$\begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} = -2\xi \begin{bmatrix} 0 & -\dot{\theta}_3 & \dot{\theta}_2 \\ \dot{\theta}_3 & 0 & -\dot{\theta}_1 \\ -\dot{\theta}_2 & \dot{\theta}_1 & 0 \end{bmatrix}$$

Vortex motion can be represented as a vortex tensor and be related to stress tensor. Spin motion can also be represented by a spin tensor and be related to stress tensor.

In the example shown, we assume zero aether translational oscillation or flow velocity. Assuming aether particles all spin in the same direction outward, it will result in a downward stress as shown on the right-hand side surface of the left-hand side cube.

Because spin and vortex motion are coupled, the spin strain tensor is the same as the vortex strain tensor except the vortex velocity is replaced with spin velocity. Stress due to vortex motion with unit vortex velocity is equivalent to stress due to spin motion with unit spin velocity. Spin strain tensor can be related to stress tensor using the same constant that relates vortex strain tensor to stress tensor.

1.33 Stress Due to Vortex and Spin



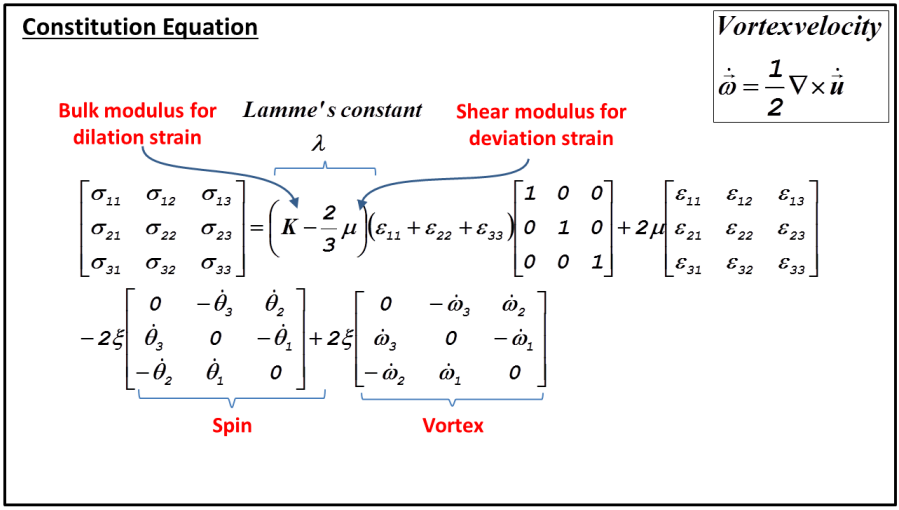
Because vortex strain tensor and spin strain tensor are directly related to stress tensor with the same constant, these two stress-strain relationship equations can be combined into one equation as shown.

In the example shown, a vortex velocity with an outward direction is caused by a counterclockwise aether flow velocity $\dot{\vec{u}}$. Which mean $\dot{\vec{\omega}} = \frac{1}{2}\nabla \times \dot{\vec{u}}$ points outward as shown in the figure above. This will result in a positive stress (upward in direction $\vec{e}_2$) on surface S_1. This relationship is shown in the element of row 2 column 1 in the matrix.

Also in the example shown, all aether particles have a uniform spin motion with an outward direction. The spin motion will result in a negative stress (downward in direction $\vec{e}_2$) on surface S_1. This relationship is observed in the combined stress-strain relationship.

We now consider a special case: if a box is rotating about its center and we assume all aether particles inside the box do not have any movement relative to the box, then the aether particles and the box are rotated as a rigid body. Because there is no relative displacement between particles, there will not be friction forces along the particles. It is interesting to note that, in the special case, the spin velocity of the particles is equal to the vortex velocity, which is the rotation velocity of the box.

1.34 Constitution Equation



Stress in aether medium can now be related to strain from translational motion $\vec{u}$ and spin motion $\vec{\theta}$ of particles in a constitution equation as shown in the figure. The constitution equation of aether medium is formulated by combining all four stress-strain equations into one equation.

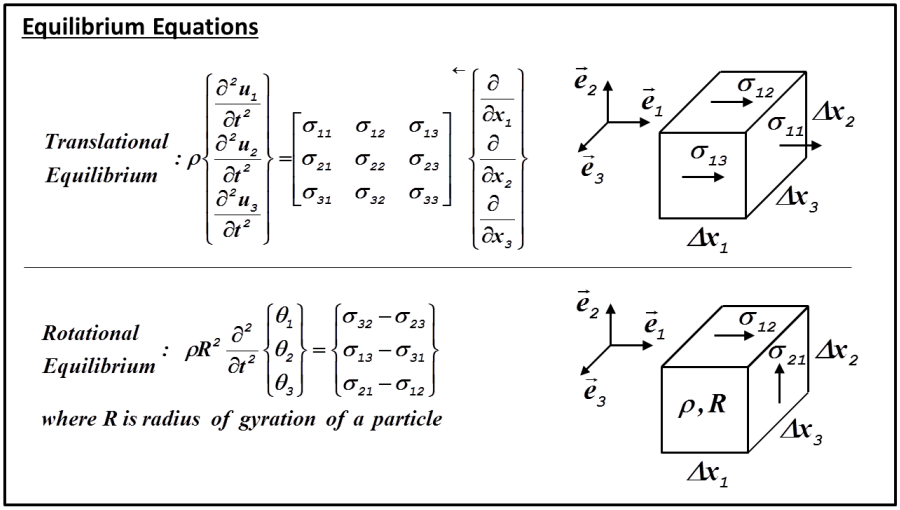
The third term and the forth term show that the spin strain tensor and the vortex strain tensor use the same empirical constant ξ to relate to stress tensor.

Bulk modulus K relates dilation strain tensor to stress. All off-diagonal terms in the strain are zero because the deformation due to hydrostatic stress creates no twist.

The shear modulus can be separated into two terms. Strain with zero off-diagonal elements can be merged into the bulk modulus because both of them have zero off-diagonal elements. The strain tensor with zero off-diagonal elements has a combined constant of bulk modulus and $\frac{2}{3}$ of shear modules. The combined constant is often referred to as Lamme's constant λ.

In this constitution equation of aether medium, there are three empirical constants: K, μ and ξ. We do not know the values of these three empirical constants of the aether medium at this time.

1.35 Equilibrium Equations

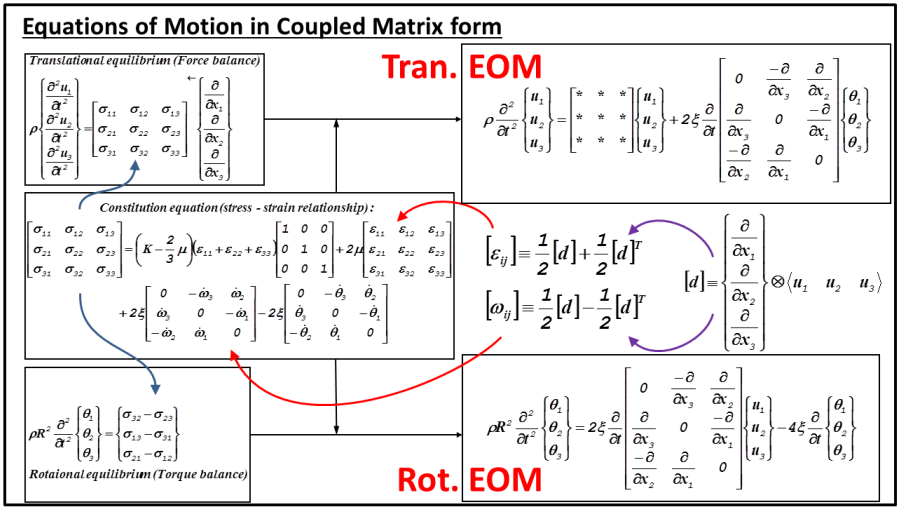


Equilibrium equation relates acceleration of an object to a force based on Newton's second law of motion. For rigid body, Newton's second law of motion is simply $F = Ma$. Where F is external force, M is the mass of the rigid body, and a is the resulting acceleration.

For continuum medium, Newton's second law of motion is applied to an infinitesimal volume as shown in the figure. The translational equilibrium equations in three directions $(\vec{e}_1, \vec{e}_2, \vec{e}_3)$ are placed in a matrix as three rows. For example, the first row is the force balance in direction $\vec{e}_1$. The left-hand side of the equation is the inertia force of the volume due to the translational acceleration. The right-hand side of the equation is the net force resulting from the stress difference on the surfaces of the volume, that is the differential of three stresses $(\sigma_{11}, \sigma_{12}, \sigma_{13})$. The first subscript of the stress symbol σ indicates the direction of force. The second subscript of the stress symbol indicates the normal direction of surface where the stress is observed. Three translational equilibrium equations are formulated in a 3 by 3 matrix as shown on the top of the figure.

For rotational degree of freedom, three rotational equilibrium equations are also placed in a matrix as three rows. The first row is the torque balance in the direction $\vec{e}_1$. The left-hand side of the equation is inertia torque due to rotational acceleration. The right-hand side of the equation is the stress that contributes to this torque. Two stresses that can cause torque in direction $\vec{e}_3$ are σ_{12} and σ_{21} as shown in the figure. Where σ_{21} is stress in direction $\vec{e}_2$ on the surface normal to direction $\vec{e}_1$. σ_{21} can create a positive torque as shown in the third row of the matrix.

1.36 Equations of Motion in Coupled Matrix Form

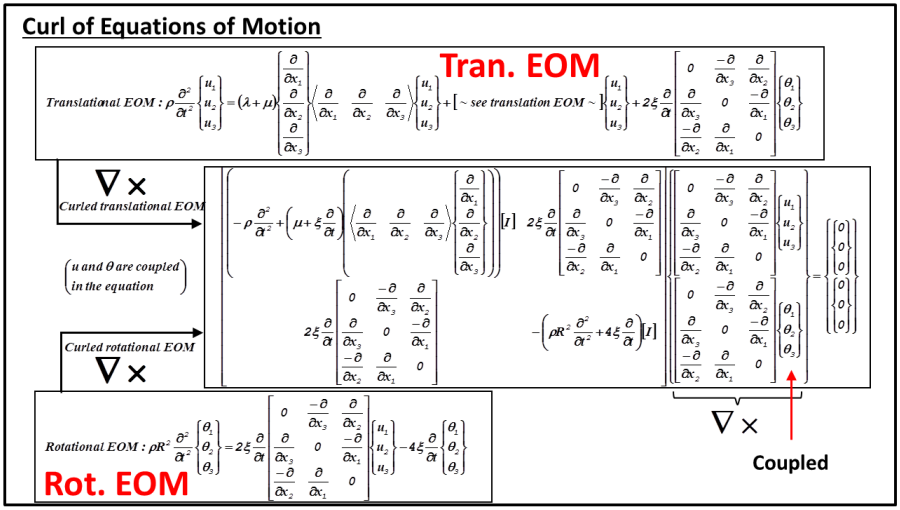


Equation of motion of aether medium will be used to derive the wave equation of electro-magnetic wave. It will be shown that the electro-magnetic wave from solving the equations of motion of aether medium is the same as that from Maxwell's equation. The results are shown in "Newton's Law of Motion Based Substantial Aether Theory for Electro-Magnetic Wave" published in the *Journal of Mechanics* in 2014.

In the paper, derivations are carried out with tensor format to save space. However, tensor format could be difficult to understand for those who are not familiar with tensor. To clarify the proposed theory, some tensors are expressed in three formats in this book: tensor format, vector format and matrix format. Despite the greater amount of space required to express tensor in all three formats, such an endeavor serves to best illustrate the theory.

Here is how the equation is derived. Equation of motion is derived from two equilibrium equations (translational and rotational) and the constitution equation. First, replace stress tensor in equilibrium equations (translation and rotational) with strain tensors using constitution equation to get equations of motion in translational and rotational directions. Second, deformational strain and spin strain are replaced with displacement vector $\vec{u}$ and spin vector $\vec{\theta}$. Third, rearrange the equation to separate displacement vector $\vec{u}$ and spin vector $\vec{\theta}$.

1.37 Curl of Equations of Motion



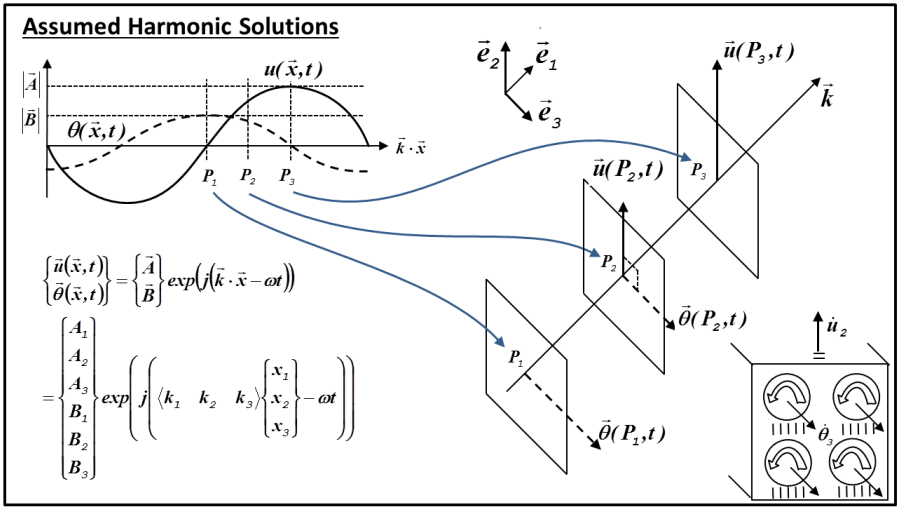
Based on aether mechanics, electro-magnetic wave results from shear stress in aether medium. In order to show the deformation due to shear stress, curl operation is taken on both sides of the equations of motion in both translational and rotational directions. In continuum mechanics, the wave equation derived from the curl of the equations of motion is called S-wave (secondary wave). The oscillation direction of S-wave is perpendicular to the wave propagation direction and the oscillation direction of P-wave (primary wave) which is wave due to normal stress.

The translational equation of motion of aether medium is shown on the top of the figure. The rotational equation of motion of aether medium is shown on the bottom of the figure. Curl operation is a derivative operator and is written in 3 by 3 matrix form to simplify the calculation.

The result of taking the curl operation of three translational EOMs is placed on the top three rows of a 6 by 6 matrix. The result of taking the curl operation of three rotational EOMs is placed on the bottom three rows of the same 6 by 6 matrix. The reason that displacement u and spin angle θ are arranged into one vector is that these variables are coupled. It is easier to solve coupled equations in matrix form.

The physical meaning of displacement variable u and spin variable θ will be explained next.

1.38 Assumed Harmonic Solutions



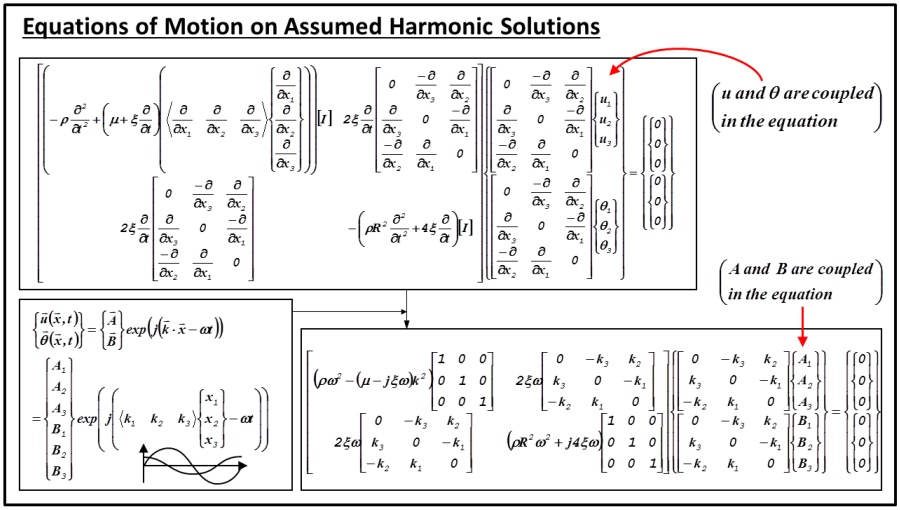
In the previous section, we have the curled EOMs of aether medium of all 6 DOFs in a 6 by 6 matrix. The variables of these 6 coupled equations are: displacement variable $\vec{u}$ and spin variable $\vec{\theta}$. Both displacement variable and spin variable are functions of location P and time t as shown in the figure.

The displacement $\vec{u}$ refers to averaged translational oscillation motion of a group of aether particles. In the lower right corner of the figure, the displacement u_2 refers to vertical oscillation displacement in a finite small volume at that location. The translational displacement does not refer to individual particles, it refers to averaged displacement of particles at the location. The averaged displacement from the steady flow is neglected in the study of electro-magnetic wave.

The spin angle $\vec{\theta}$ does not refer to individual particles neither. The spin angle $\vec{\theta}$ refers to averaged spin angle of particles in a finite small volume at that location. In the lower right corner of the figure, the spin angle θ_3 points outward because aether particles around that location have a counterclockwise spin.

The wave solutions of the curled translational and rotational equations of motion are solved by assuming displacement vector has a maximum vector $\vec{A}$ and spin angle has a maximum vector $\vec{B}$. Vector $\vec{A}$ and vector $\vec{B}$ have different magnitudes and directions. Assume wave is traveling along direction vector $\vec{k}$. Assume vector $\vec{A}$ and vector $\vec{B}$ are oscillating at the same frequency of ω but different phases. We will solve for vector $\vec{A}$ and vector $\vec{B}$ for the direction vector $\vec{k}$ and frequency ω in the next few sections.

1.39 Equation of Motion on Assumed Harmonic Solutions



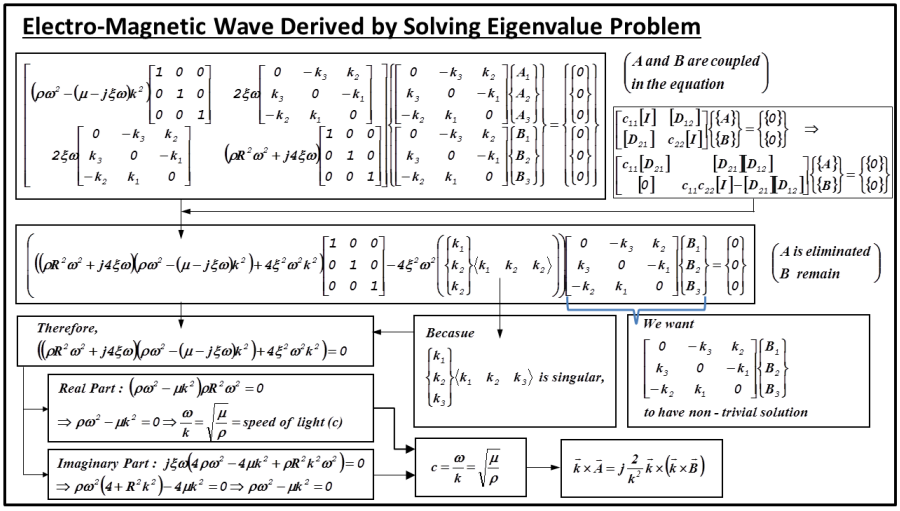
The curled EOMs shown on the top of the figure are coupled partial differential equations. These differential equations can be transformed to non-differential equations as shown on the lower right of the figure. These non-differential equations can be solved as eigenvalue problem.

The assumed harmonic solutions for displacement $\vec{u}$ and spin $\vec{\theta}$ are shown again in the lower left of the figure. After substituting the assumed harmonic solutions of displacement $\vec{u}$ and spin $\vec{\theta}$ into the curled EOMs, coupled variables $\vec{u}(\vec{x},t)$ and $\vec{\theta}(\vec{x},t)$ are replaced with two vectors $\vec{A}$ and $\vec{B}$ as shown in the lower right of the figure. Vectors $\vec{A}$ and $\vec{B}$ are time independent variables. The parameters of oscillation frequency ω and wave propagation direction $\vec{k}$ are now inside the matrix.

After substituting the assumed harmonic functions into the curled EOMs, all derivative terms can be replaced with $\vec{k}$ and ω. The details of these operations are shown in chapter 10 and appendix A.

Curl operation is also a derivative operator and is shown as a 3 by 3 matrix in the top of the figure. When this derivative operator is acting on the assumed harmonic solutions of $\vec{u}$ and $\vec{\theta}$, the derivative operators becomes constant values k_1, k_2 and k_3. The matrix form of the curl operator for harmonic solution will simplify the procedures for solving the eigenvalue problem in the following few sections.

1.40 Electro-Magnetic Wave Derived by Solving Eigenvalue Problem

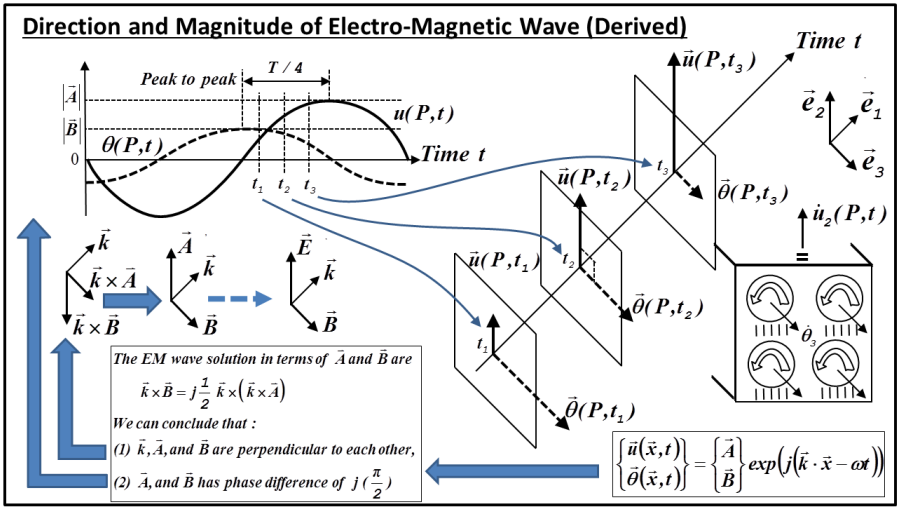


Electro-magnetic wave of displacement $\vec{A}$ and spin $\vec{B}$ are coupled and related to propagation direction $\vec{k}$ as shown in the lower right of the figure. Vectors $\vec{k} \times \vec{A}$, $\vec{k} \times \vec{B}$ and $\vec{k}$ are perpendicular to each other as expected. There are two major steps required to get the finial electro-magnetic wave equation (shown on the lower right) by solving the linear algebra problem of the 6 by 6 matrix shown in the upper left.

The first step is to eliminate variables $A_i\,(A_1, A_2, A_3)$ by static condensation. The static condensation for this particular example is simplified and shown on the upper right of the figure as a reference to the actual operation. The goal of the operation is to make the sub-matrix21 (row 2 and column 1) of the matrix to be zero by subtracting row 2 (after multiplying $[A_{21}]$) by row 1 (after multiplying a_{11}). As a result, the second row of the reduced matrix contains only variable $B_i\,(B_1, B_2, B_3)$. Which means variables A_i are removed from the second row. The reduced 3 by 3 matrix makes the eigenvalue problem easier to solve.

The second step is to solve the eigenvalue problem of the reduced matrix. The second equation in the figure is a reduced matrix with variable $\{B\}$. Our objective is to get nontrivial solution of $[k]\{B\}$. Because $\{k\}\langle k\rangle$ is singular, the terms before the unit matrix $[I]$ must also be zero. Those terms before the unit matrix $[I]$ are complex numbers. Therefore, both the real part and the imaginary part must be zero. Wave propagation velocity can be obtained from either equations and is equal to the square root of μ divided by density ρ. The final solution can be obtained by substituting the eigenvalue to the original matrix.

1.41 Direction and Magnitude of Electro-Magnetic Wave



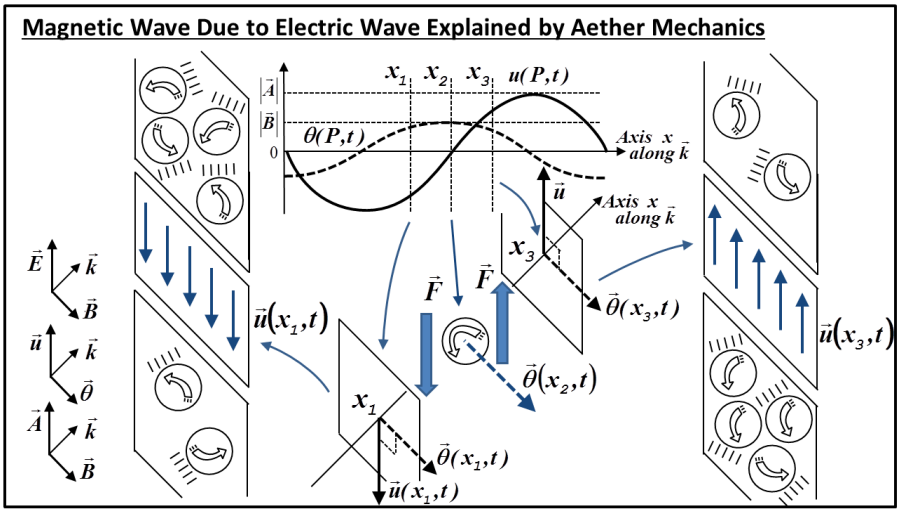
The most important thing to understand how aether mechanics explains electro-magnetic wave is to understand the physical meaning of translational displacement $\vec{u}$ and spin angle $\vec{\theta}$. As shown in the lower right corner of the figure, translational velocity u_2 represents averaged velocity of particles in a finite volume. Spin velocity $\vec{\theta}$ also represents an average spin velocity of particles. The averaged spin velocity is not zero when the spin motions of particles are aligned in the same direction.

It is shown in the wave equation that three vectors $(\vec{k}, \vec{k}\times\vec{A}, \vec{k}\times\vec{B})$ are perpendicular to each other and following the right-hand rule as: $\vec{k}\times(\vec{k}\times\vec{A})$ is parallel to $\vec{k}\times\vec{B}$ as shown. If $\vec{A}$ is perpendicular to $\vec{k}$ as a special case, the relationship of $\vec{k}, \vec{k}\times\vec{A}$ and $\vec{k}\times\vec{B}$ can be further simplified to $\vec{k}\times\vec{A}$ is parallel to $\vec{B}$ and $\vec{k}\times\vec{B}$ is parallel to $\vec{A}$ as shown. Now we can compare this result to electro-magnetic wave which is also $\vec{k}\times\vec{E}$ equals $\vec{B}$ as shown before. The results show that two shear waves (translational and spin waves) are perpendicular to the wave propagation direction.

Because of this we can also know that $\vec{A}$ and $\vec{B}$ has a phase difference of $\frac{1}{2}\pi$ since $j = e^{j\pi/2}$. The phase difference of $\frac{1}{2}\pi$ is shown in the upper left of the figure.

Combining all the informations of solved wave equations, three dimensional illustration of $\vec{u}$, $\vec{\theta}$ and $\vec{k}$ is shown in the figure. To compare $\vec{u}$, $\vec{\theta}$ and $\vec{k}$ to electro-magnetic wave, we can conclude that translational displacement $\vec{u}$ is related to the curl of electric field and spin angle $\vec{\theta}$ is related to the curl of magnetic field.

1.42 Magnetic Wave Due to Electric Wave Explained by Aether Mechanics



In the previous section we made two strong statements that:

1. Aether translational displacement $\vec{u}$ is directly related to electric field $\vec{E}$.
2. Aether spin angle $\vec{\theta}$ is directly related to magnetic field $\vec{B}$.

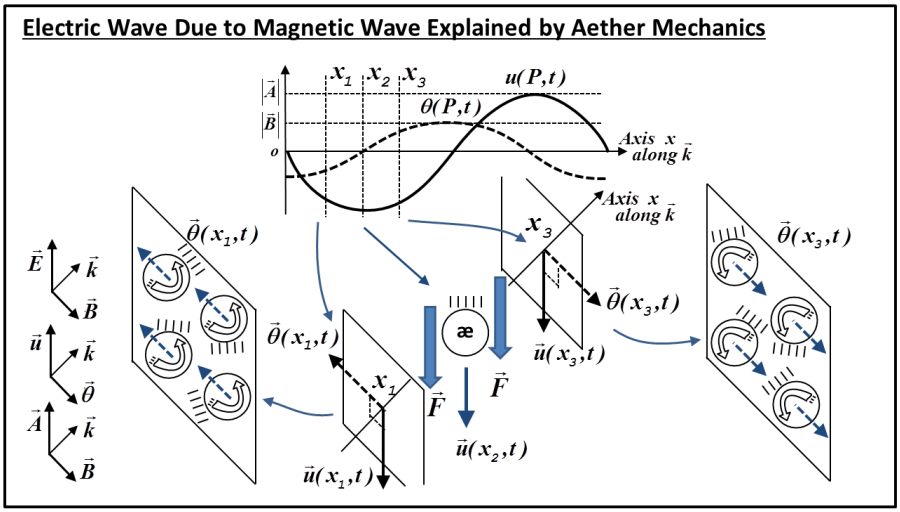
We will test this statement to see if it can be used to explain the relationship between electric wave and magnetic wave as shown in the plot in the top of the figure. In this section, we will show that spin motion will be generated from translational motion following the wave equation we derived.

For a fixed time t, electric forces at two different locations x_1 and x_3, are shown in the figure as $E(x_1, t)$ at the left-hand side and $E(x_3, t)$ at the right-hand side. For the fixed time t, the electric and magnetic forces are shown as functions of location x in the figure. The electric force is represented by a solid line and the magnetic force is represented by a dotted line.

It shows that the electric force is negative at location x_1 and positive at location x_3. Because electric force is explained as aether flow, the difference in flow direction of aether particles at locations x_1 and x_3 will cause aether particles to spin at location x_2. The spin motion of aether particles is directly related to magnetic force.

For a fixed location x_2, when the translational displacement at x_1 and x_3 is oscillating, the spin angle at x_2 will also be oscillating. The interaction of the translational displacement $\vec{u}$ and the spin angle $\vec{\theta}$ behave the same way as electromagnetic wave does.

1.43 Electric Wave Due to Magnetic Wave Explained by Aether Mechanics



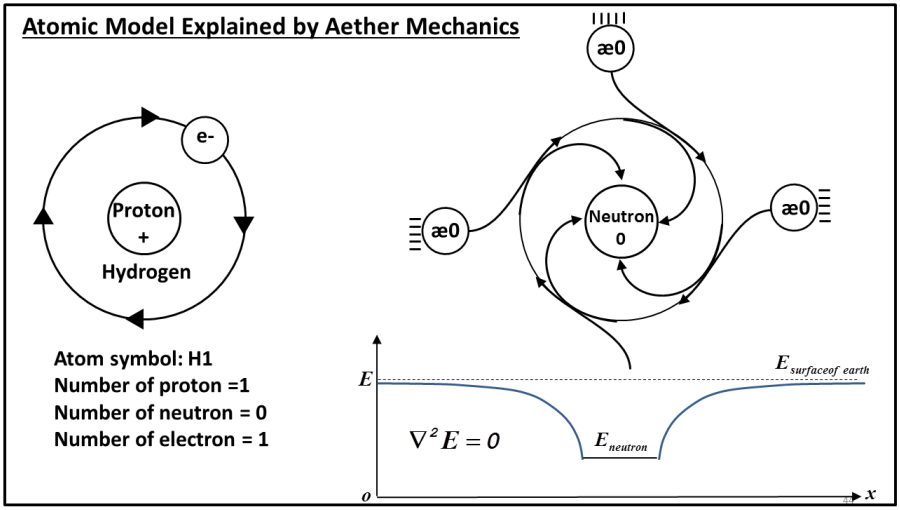
To continue and reverse what we did in the previous section, we will now show that translational displacement oscillation will be caused from spin angle oscillation.

For a fixed time t, spin angles at two different locations x_1 and x_3, are shown in the figure as $\vec{\theta}(x_1,t)$ at the left-hand side and $\vec{\theta}(x_3,t)$ at the right-hand side. For the fixed time t, the translational displacement $\vec{u}$ and spin angle $\vec{\theta}$ are shown as functions of location $\vec{x}$ in the figure. The translation displacement $\vec{u}$ is represented by a solid line and spin angle $\vec{\theta}$ is represented by a dotted line.

The figure shows that the spin angle is negative at location x_1 and positive at location x_3. The difference in spin direction of aether particles at location x_1 and x_3 will cause aether particles at location x_2 to move. The downward displacement $\vec{u}$ is negative because we have defined the positive direction of $\vec{u}$ is upward as shown in the figure.

For a fixed location x_2, when the spin angle $\vec{\theta}$ is oscillating at x_1 and x_3 as a harmonic wave, the translational displacement $\vec{u}$ will also oscillate as a harmonic wave.

1.44 Atomic Model Explained by Aether Mechanics



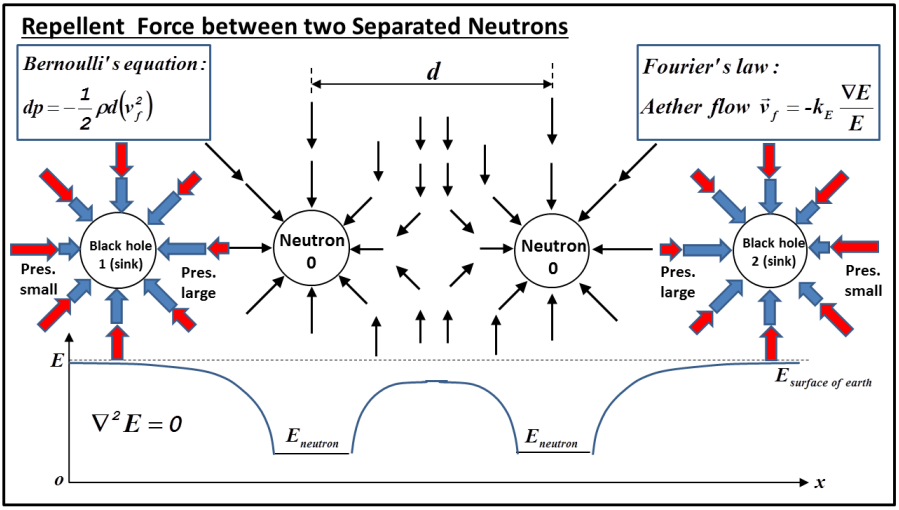
So far we have modeled electric field as a force that can cause aether particles to have translational motion including oscillation and flow. For electromagnetic wave, we only consider oscillation due to electric field. For electric current, we only consider flow motion. In this section, we will extend the concept of aether flow as negative charges moving in vortex motion around a nucleus.

The simplest atomic model is Hydrogen which is made of a proton with a positive charge and an electron with negative charge. The positive charged proton is located at the center of the atom and the negative charged electron is moving around the proton like an electron cloud.

According to aether mechanics, atoms do not have any electric charge. Instead, an atom is made of uncharged neutrons and uncharged aether particles. The neutrons are located at the center of the atom. A neutron has mass but does not have any electric charge. Because a neutron is much heavier and larger than an aether particle (estimated to be 10^{10} heavier than the mass of an aether particle), a neutron is a sink of aether particles. The aether particles will flow into the neutron sink in a vortex motion as shown in the figure.

In summary, there is no need for an electric charge nor for a positive charged proton. Nucleus is made of only neutrons without electric charge. Attraction between protons and electrons is explained as the coupled behavior of the aether particles flowing into the neutron sink.

1.45 Repellent Force between two Separated Neutrons



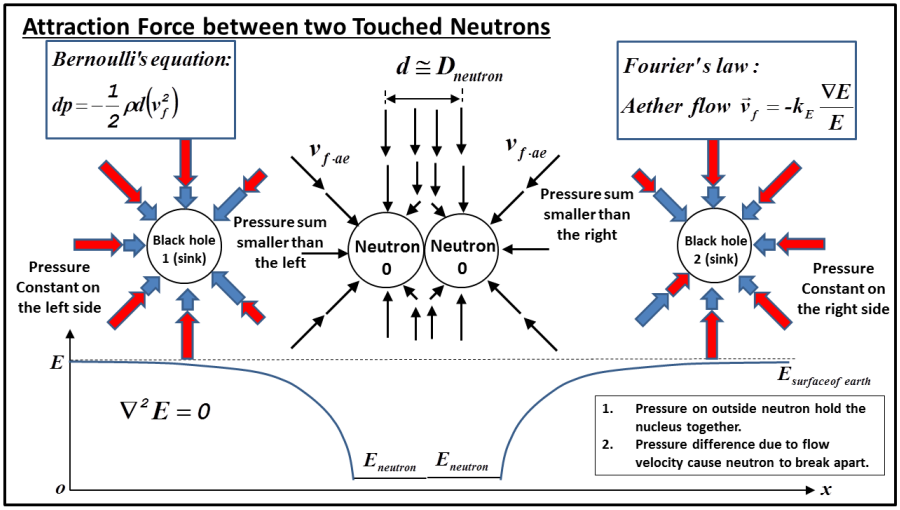
Based on the proposed aether mechanic model, a proton is replace with a neutron. So the question is whether aether mechanics can explain the repellent force between two neutrons. The answer is yes. The explanation of the repellent force between two neutrons is similar to the explanation for the anti-gravitational force between two black holes. It will be explained using two neutrons as an example as follows.

Because the energy density on the surface of neutron is lower than the surrounding aether energy density, therefore, aether particles flow into the neutron based on Fourier's law. The energy density along the line passing through two neutrons is solved form Laplace's equation and is shown at the bottom of the figure. The gradient of energy density on the surface of the neutrons at the facing sides is smaller than that at the opposite sides. Therefore, aether flows slower on the facing side than on the opposite side.

According to Bernoulli's equation, there will be higher pressure on the facing side of a neutron than on the opposite side. The summation of all pressure on the surface of a neutron will result in a repellent force. This repellent force is similar to Columbus's law for two protons.

When two protons are placed at a very short distance or attached to each other inside a nucleus the repellent force could be very large according to Columbus's law. One of four fundamental forces is a strong force that can bind this large electric force between two protons inside a nucleus. The following section will explain how such a repellent force simply ceases to exist when two neutrons are very close and attached to each other.

1.46 Attraction Force between two Touched Neutrons



The following section will explain why the repellent force can DISAPPEAR when two neutrons are placed very close to each other in a nucleus. Actually this REPELLENT force not only DISAPPEARS but also BECOMES an ATTRACTION force.

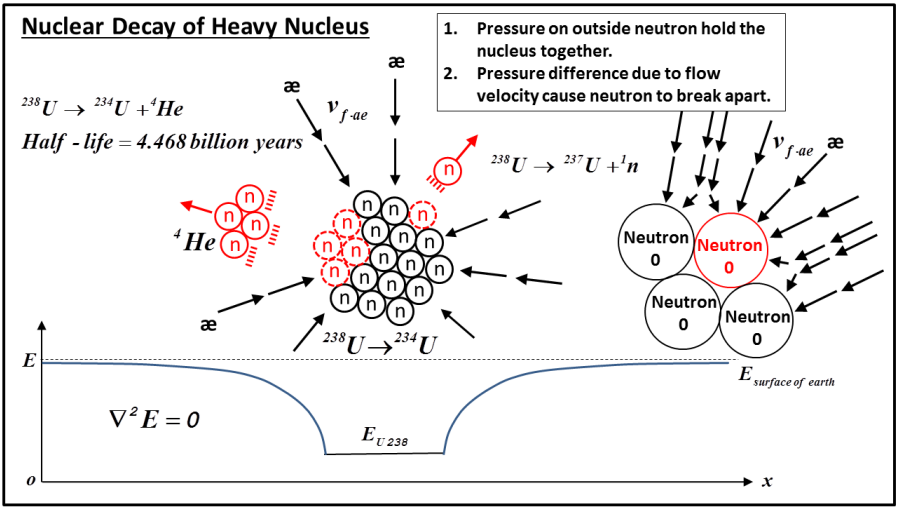
In the previous section, there is a repellent force between two neutrons which are placed at a distance d apart from each other. In this section, two neutrons are located very close to each other in the nucleus. The energy density along the line passing through two neutrons is solved form Laplace's equation and is shown at the bottom of the figure. There is no energy density change between two neutrons because two neutrons are very close to each other. There are two different forces against each other on the surface of neutrons.

First, pressure on the outside neutron holds the nucleus together. Even though two neutrons are still the same sinks as they are separated, two neutrons behaved like a single sink.

Second, pressure difference due to flow velocity causes neutrons to break apart. Similar to two separated neutrons, aether flows slowly on the facing surface of a neutron and will result in a larger pressure than on the surface with faster aether flow. Such will result in a repellent force on the neutron.

Because two neutrons are placed very close to each other, the first force should be larger than the second force and will result in an attraction force instead of the previous repellent force. It will be shown in the next section that this attraction force will not be enough to hold an atom with a large number of neutrons together.

1.47 Nuclear Decay of Heavy Nucleus



In the proposed atomic model, nucleus is made of neutrons only. The positive charged proton is not needed in the model. The negative charged electron is also not needed in the model. The electric attraction force between a proton and an electron is explained by considering the neutron as a sink of aether particles.

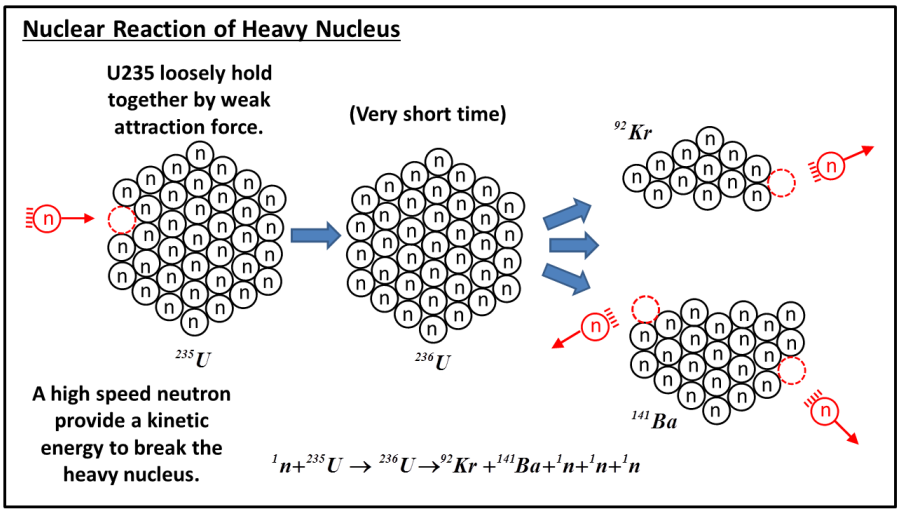
In this section, the nucleus decay will be mechanically explained by the proposed atomic model. Nucleus decay happen at a heavy nucleus such as U238. In the proposed atomic model, the nucleus does not have protons. There we assign a number of protons to the number of neutrons to replace the mass of protons with mass of neutrons. For example, U238 will have no proton but 238 neutrons.

Heavy elements with large mass number such as U238 can decay to elements with smaller mass number over time. For example, U238 can decay to U234 by losing a Helium-4.

In the previous section, two forces against each other in a nucleus are shown on the upper right corner. First, pressure on the outside neutron holds the neutrons together. Second, pressure difference due to flow velocity causes neutron to break apart.

When a nucleus is big with several neutrons in a nucleus, the first attracting force will be not enough to hold all 238 neutrons together and will result in a nucleus decay to U234 by losing a Helium-4. The half-life of U238 is 4.468 billion years.

1.48 Nuclear Reaction of Heavy Nucleus

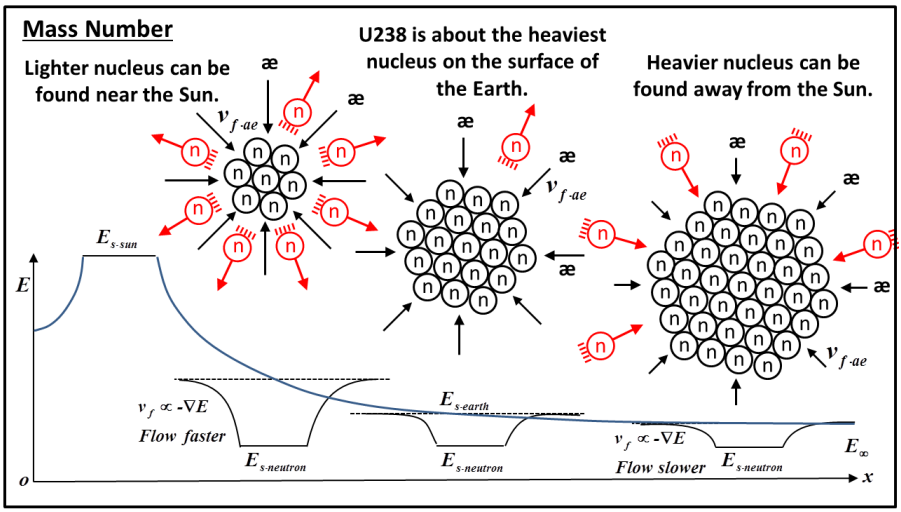


A nuclear reaction of a heavy element can be triggered by a high speed neutron. For example, a nuclear reaction of U235 can be triggered by a high speed neutron and becomes two smaller nuclei Kr92 and Ba141 and three high speed neutrons. The split of U235 into Kr92 and Ba141 is due to the following two reasons.

First, heavy nuclei are not stable due to the large number of neutrons. The attraction forces due to pressure differences on the surface of a nucleus are not capable of holding a large number of neutrons.

Second, the high speed neutron provides a kinetic energy that can break the loosely held heavy nucleus U235 into pieces (Kr92 and Ba141 and 3 neutrons).

1.49 Mass Number

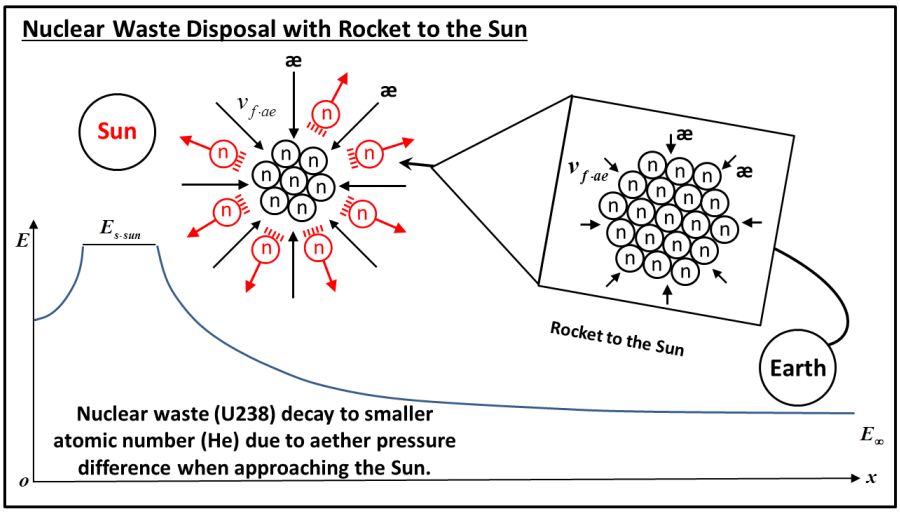


The heaviest nucleus can be found on the surface of the earth is about 238 neutron mass (U238). The U238 is not exactly the heaviest nucleus on the surface of the earth. But a nucleus with number of neutrons higher than 238 is very unstable on the surface of the earth because the attraction force due to aether flow difference is not strong enough to hold a large number of neutrons together. When the attraction force is weaker than aether flow pressure, neutrons will escape (or will be radiated) and will result in a lighter nucleus.

When a nucleus is approaching the Sun (which has a much higher energy density than the Earth), aether flows faster due to a higher energy density difference between the surrounding energy density and the neutron energy density. Because aether flows faster, pressure due to velocity difference following Bernoulli's equation will also be greater. As a result, the nucleus will decay much faster (as it has a shorter half-life due to the aforementioned circumstances) or split into multiple smaller nuclei at a location near the Sun.

It is predicted by aether mechanics that heavy nuclear, such as U238, can not exist at high energy density conditions near the Sun. On the other hand, when nucleus is moving away from the Sun to the outer area of our solar system, aether flows slower due to the lower energy density difference between the surrounding energy density and the neutron energy density. Because aether flows slower, pressure due to velocity difference following Bernoulli's equation becomes so small that the aether flow brings surrounded neutrons into the nucleus and creates an even heavier nucleus(heavier than U238).

1.50 Nuclear Waste Disposal with Rocket to the Sun



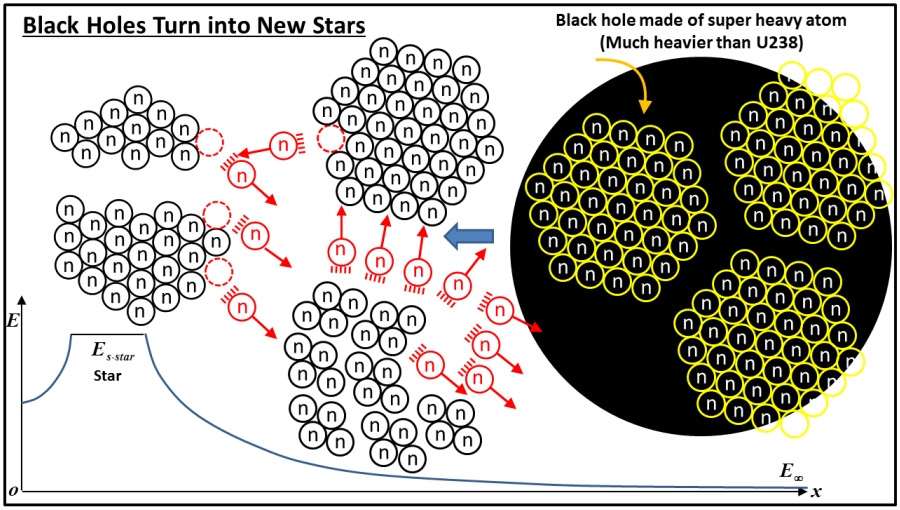
If the prediction that a heavier nucleus could not be found at a location near the Sun is correct, it is possible to dispose the nuclear waste by placing nuclear waste in any high aether pressure environment.

If we can have a container that holds aether particles like a glass bottle holds water, we can increase the aether particles inside the container and create a high aether pressure environment to dispose the nuclear waste. However, it seems that no material can hold aether particles because aether particles seem to pass through any material we know.

This book proposes another possible solution (possible yet perhaps impractical) for nuclear waste disposal by throwing nuclear waste (usually made of heavy nuclei) toward the Sun by a rocket ship as shown in the figure.

As the rocket approaches the Sun, the energy density become higher than what is on the Earth. As a result, these heavy nuclei will either decay into smaller nuclei or initiate a nuclear reaction and split into smaller nuclei. Either way, in the aforementioned scenario, the nuclear wastes are disposed of and will cause no harm to humans and the universe. Nuclear wastes will simply be recycled into smaller nuclei.

1.51 Black Holes Turn into New Stars



Aether Mechanics predicts that a black hole turns into a new star through nuclear decay and initiates a nuclear reaction when its surrounding energy density is high enough to cause nuclear decay at a fast rate and may cause nuclear chain reactions. In the beginning, a black hole is made of super heavy nuclei (much heavier than U238) and located in a very low energy density area far away from any solar system like our Sun. Even though the nuclei are very large and heavy, it is stable because the surround energy density is very low and causes very small aether flow.

When the black hole approaches a solar system, the surrounding energy density increase. When the surrounding energy density increase to a point that causes the neutron (n) to break apart from the nucleus, the black hole can undergo nuclear chain reactions because the atomic volume is far bigger than the critical volume of a nuclear chain reactions thresh hold.

Once a black hole undergoes nuclear chain reactions, it will generate several high speed neutrons and explode like a super large nuclear bomb in a very short period of time. Based on the initial spin of the black hole, the explosion of the black hole will generate new rotating planets such as the Earth and Mars to the Sun. The black hole becomes a new star with a very small nucleus such as Helium and continues to generate energy through nuclear fusion.

On the other hand, a star like our Sun can lose all of its energy and will turn into a black hole.

ISBN: 0986388408
ISBN-13: 978-0986388408
First Edition