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The Theory of Observation
—The Propagation of Wave and the Apparent Velocity of Object Motion

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Abstract

This paper deepens and develops the Galileo's principle of relativity of motion, and summarizes the Laws of relativity and superposition of motion or wave (light). The essence of light is analyzed. The characteristics of various waves (sound waves, water waves, electromagnetic waves or light waves, etc.) and their relationship with the motion velocity of objects (wave sources) are analyzed. Wave acts as a messenger for people to know things, and are used as a signal to receive, perceive and know things far away. The observation of an object is a perspective effect, not represent the real motion of the object. The real motion of the wave source can exceed the velocity of wave, and the observed velocity of the object moving at the super wave (light) velocity can be much lower than the wave (light) velocity in some visual angles, while the observed speed of the object moving below the wave (light) speed will be much higher than the wave velocity in some visual angles. Objects moving at super wave (light) speed will produce special phenomena when observed from some angles. Super wave velocity (including superlight velocity) of real motion of objects and inversion of observation time sequence are common phenomena. Finally, the superluminal phenomenon of quasars and the technical application prospect of observation angle effect are discussed. This theory is widely used in remote sensing, astronomical observation, microscopic detection, satellite navigation, weather forecast, microscopic observation, medical detection, dynamic identification and so on. All of them are calibrated by the formula of observation angle effect derived in this paper, which can improve the accuracy of observation results. Especially in the observation technology of objects moving in high-speed such as high-energy collider, cosmic ray, cosmic radiation and nuclear reaction, the application effects are more remarkable, more real and accurate.

Keywords: Laws of Relativity and Superposition of Motion or Wave, Essence of Light, Wave Propagation, Constant Wave Velocity, Signal, Apparent Velocity of Object, Observation Angle Effect, Superwave Velocity, Time Sequence Inversion.

1. Introduction

When the object system is disturbed, the disturbance forms waves when it propagates in space, such as rope waves, water waves, sound waves, temperature waves, electromagnetic waves or light waves. Except electromagnetic wave can propagate in vacuum, other waves can only propagate in medium. The common characteristics of waves are reflection, refraction, superposition, interference, diffraction and polarization.

In addition to above properties, waves also have following obvious properties: the speed of waves is determined by the type of media and its state factors; wave propagation is not affected by force, and will not be accelerated or decelerated. There is no process of acceleration or deceleration, and the direction of wave propagation will not be changed in same homogeneous medium. When the wave source vibrates, it immediately fluctuates and propagates at a constant wave speed.

Relative to the medium, the motion of the wave source does not affect the propagation speed and direction of the wave. The wave propagates immediately after it is generated from the wave source, and has nothing to do with the wave source since then. Each wave generates and propagates independently of each other, and similar waves meet and overlap, and then propagate independently after separation. Waves propagate energy, but not mass. Therefore, waves have no mass and no inertia. These unique properties of wave determine the unique behavior of wave, which is also obviously different from the physical properties of the entity substance.

Human beings perceive and know things through waves, but at present, there is no complete and in-depth study on how waves transmit information of things, make people's senses and instruments perceive and receive waves, the relationship between wave propagation and wave source movement, and whether the information received by people's senses or instruments truly reflects the real movement of objects, which makes people mistakenly think that what they observe is the real situation.

In fact, in the existing classical physics theory and modern physics theory, as well as in physical experiments, observation and technical applications, the influence of observation angle effect on observation results are not considered, which are great and complicated. Ignoring it will lead to errors in physical theory. Because the results obtained in some physical experiments and observations are not true, many technical applications encounter development bottlenecks.

This paper discusses the propagation of linear waves in isotropic homogeneous media and the influence of waves as observation messengers on observation results. It is pointed out that the motion of the object observed by people is not the real motion of the object, but only the visual motion of the object, and the relationship between the motion of wave source and visual observation under various conditions is given. This paper also analyzes the visual phenomenon of superluminal, and modifies the related physical theory and the observation of physical experiments, making the theory more accurate and the results of physical experiments and observations more real and effective.

This theory has a wide application prospect in remote sensing and telemetry, astronomical observation, microscopic detection, satellite navigation, weather forecast, microscopic observation, medical detection, dynamic identification and so on. In order to improve the accuracy of observation results, the observation angle effect derived in this paper is used to correct it. Especially in the observation technology of high-speed moving objects such as high-energy collider, cosmic ray and nuclear reaction, the application effect are more remarkable. Through the revision proposed in this paper, a more real and accurate result is obtained.

The subscripts of motion or wave parameters (displacement ***S***, velocity ***V***, acceleration ***A***) used in this paper are respectively, ***w***(wave) represents the parameters of moving objects or waves, ***o***(observer) represents the motion parameters of observers or sensors, ***m***(medium) represents the overall motion parameters of media, ***s***(source) represents the motion parameters of wave sources (real velocity), and ***a***(apparent) represents the observation of observers or sensors.

2. The Laws of Relativity and Superposition of Motion or Wave

The Galileo's relative principle of motion: For relative motion (displacement, velocity and acceleration), the observed relative motion parameter ***c***' in any reference system is the vector difference between the motion parameter ***c*** and the motion parameter V_o of the reference system: $\vec{c}' = \vec{c} - \vec{V}_o$

For example, when a ship is in the river, the motion states of the ship are different when viewed from the ship, the river and the shore.

The principle of motion superposition: for superposition motion (displacement, velocity, acceleration and other parameters), the observed superposition motion parameter ***c'*** in any reference system is the vector sum of motion parameter ***c*** and motion parameter V_m of the towed object: $\vec{c}' = \vec{c} + \vec{V}_m$

For example, the overall flow of the medium drags waves, the movement of the earth drags all objects on the earth to move together, and the train drags all objects on the train to move together.

The complicated situation is that there are both relativity and superposition of motions. For example, the earth goes around the sun, trains run on the earth, people walk on the train, and bugs crawl on people.

These two principles are not only applicable to all the motion of objects, but also to all waves, so we can get the laws of motion relativity and superposition, laws of wave relativity and superposition.

The laws of relative and superposition of motion or wave: In any reference frame, the observer moves at the speed V_o. When the whole homogeneous medium moves uniformly at the velocity V_m, the wave source generates concentric spherical waves with the velocity c_w on the medium, and also moves uniformly with the medium at the velocity V_m without changing the shape (medium drag effect). The wave velocity c'_w observed by the observer at any point is the difference between the vector of the wave velocity c_w in the medium and the observer velocity V_o, and the sum of the vector of the overall motion velocity V_m of the medium, regardless of the motion velocity V_s of the wave source. It is called the general formula of relative and superposition of motion or wave velocity:

$$\vec{c}'_w = \vec{c}_w - \vec{V}_o + \vec{V}_m \quad (1)$$

The general formula of superposition of motion displacement:

$$\vec{S}'_w = \vec{S}_w - \vec{S}_o + \vec{S}_m \quad (2)$$

The general formula of superposition of accelerations:

$$\vec{a}'_w = \vec{a}_w - \vec{a}_o + \vec{a}_m \quad (3)$$

These two principles are not only suitable for all movements and waves, but also for all electromagnetic wave (light wave) velocities, so that the laws of relativity and superposition of light speed can be obtained.

The laws of relativity and superposition of light speed: in any reference frame, the observer moves at the speed V_o. When the whole homogeneous medium moves uniformly at the speed V_m, the light source produces concentric spherical light waves with the speed ***c*** on the medium, and also moves uniformly with the medium at the speed V_m without changing the shape (medium drag effect). The light's speed ***c'*** observed by the observer at any point is the difference between the vector of the speed of light ***c*** in the medium and the observer's speed V_o, and the sum of the vector of the overall moving speed V_m of the medium, regardless of the moving speed V_s of the light source. It is called the general formula of relativity and superposition of light speed:

$$\vec{c}' = \vec{c} - \vec{V}_o + \vec{V}_m \quad (4)$$

The general superposition formula of light wave displacement:

$$\vec{S}' = \vec{S} - \vec{S}_o + \vec{S}_m \quad (5)$$

The laws of relativity and superposition of motion or wave is a more universal laws, which is not only applicable to the vector subtraction relationship and the superposition vector addition relationship of object motion (displacement, velocity and acceleration), but also to the vector subtraction relationship and the superposition vector addition relationship of wave motion (displacement and velocity).

3. The Nature of Light

According to the Maxwell's electromagnetic theory, light is electromagnetic wave, which is alternately excited by electric field and magnetic field and propagates forward in space. Light can propagate not only in vacuum, but also in transparent matter (entity substance). Light is electromagnetic wave, electromagnetic waves are also light, light and electromagnetic waves are completely equivalent concepts. The same is in below.

Light has the common characteristics of reflection, refraction, superposition, interference, diffraction and polarization.

Light exists in the form of wave, not the movement form of an object. It cannot be called the movement of light, but should be called the propagation of light. What light propagates is the form of fluctuation and the energy of fluctuation. Light is not matter, has no mass, has no inertia, is not affected by force, is not accelerated or decelerated, is not dragged by light source, but can be dragged by electromagnetic field medium. In the same homogeneous substance, the direction of light will not be changed when it propagates. The light source produces light immediately when it emits light, and it propagates at a constant speed.

The movement of light source does not affect the speed and direction of light propagation. Light spreads out immediately after it is generated from the light source, and has nothing to do with the light source since then. Each light generates and propagates independently of each other, superposes when it meets, and propagates independently after being separated. Light propagates energy, no propagates mass. These unique properties of light determine the unique behavior of light, which are also obviously different from the properties of entity substance. When light is reflected by an object, the object becomes a new light source.

The principle of invariance of light speed is incorrect. Relative to the same homogeneous substance (light medium), the speed of light is the same, which is the real meaning of the constant speed of light. Vacuum is the best medium for light propagation. In vacuum, relative to the vacuum medium reference system, the speed of light is c. The speed of light satisfies the laws of relativity and superposition of light speed. The speed of light is not the upper limit of all speeds, but the movement speed of entity substance can exceed the speed of light. Vacuum is the most ideal medium for electromagnetic wave propagation, with the fastest propagation speed (c) and the lowest refractive index [1].

Although there is no entity substance as the medium in vacuum, it takes the substance in the form of electromagnetic field as the medium. The electric field and magnetic field are alternately excited and spread forward in space, the form of this fluctuation is electromagnetic wave. In the process of alternating excitation of electric field and magnetic field, the latter electric field and magnetic field weaken and disappear, excited the electric field and magnetic field in front, the electric field and magnetic field in front are generated during the excitation process. It can be seen that the propagation speed of electromagnetic waves, that is, the speed at which electric and magnetic fields are alternately excited and spread forward in space. So electromagnetic fields are the medium for electromagnetic waves to spread.

Maxwell obtained the electromagnetic wave by solving from the electromagnetic equations. The electromagnetic wave equation and the mechanical wave equation (string vibration equation) have exactly the same form. The mechanical wave velocity solved by the mechanical wave equation is relative to the medium and has nothing to do with the motion speed of the wave source. Similarly, the electromagnetic wave speed is $c = 1/\sqrt{\varepsilon_0 \mu_0}$ according to electromagnetic wave equation (where ε_0 is the dielectric constant in vacuum and μ_0 is the permeability coefficient in vacuum). The electromagnetic wave speed in vacuum is also relative to the electromagnetic field of electromagnetic wave medium in vacuum, and has nothing to do with the motion speed of wave source. The electromagnetic field of electromagnetic wave medium in vacuum is the reference system of the speed of light c in vacuum. With this reference frame determined, Maxwell's electromagnetic theory has no contradiction with Galileo's relativity principle.

In a entity substance, the electromagnetic wave speed is $c_w = 1/\sqrt{\varepsilon\mu} = c/n$ (Where ε is the dielectric constant of the solid substance, μ is the magnetic permeability coefficient of the solid substance, which is not only related to the solid substance, but also related to the frequency of electromagnetic waves, and n is the refractive index of the transparent solid substance to light). Similarly, the electromagnetic wave velocity of the entity substance is relative to the electromagnetic wave medium electromagnetic field in the entity substance, and has nothing to do with the movement of the wave source. The electromagnetic wave medium electromagnetic field in the entity substance is the reference system of the light speed c_w in the entity substance.

When light propagates in (transparent) entity substance, it also uses electromagnetic field as the propagation medium. The (transparent) entity substance is not the propagation medium of light, but the electromagnetic field is the propagation medium of light.

Electromagnetic field propagates slowly in solid matter, and light propagates slowly in (transparent) entity substance, which is $c_w=c/n$. The overall movement (flow) speed of the entity substance is not synchronous with the propagation speed of the electromagnetic field in the entity substance, which leads to that the propagation speed of light in the transparent entity substance is not synchronous, but lags behind. That is, the entity substance, does not completely drag the electromagnetic field synchronously, nor does it completely drag the electromagnetic wave synchronously, it's all just a partial drag. The entity substance drags the electromagnetic field in a certain proportion, and the two actions slow down the propagation speed of light by the whole moving (transparent) entity substance, which is related to the dielectric constant and density of the entity substance.

All waves (including electromagnetic waves) are body waves inside the medium and surface waves at the interface of the medium. There are both transverse waves and longitudinal waves in body waves. Surface waves at the interface of medium are transverse waves, while body waves in medium are longitudinal waves. Any curved surface parallel to the propagation direction in the medium is transverse wave, and any curved surface perpendicular to the propagation direction in the medium is longitudinal wave. As shown in Fig.1 (1).

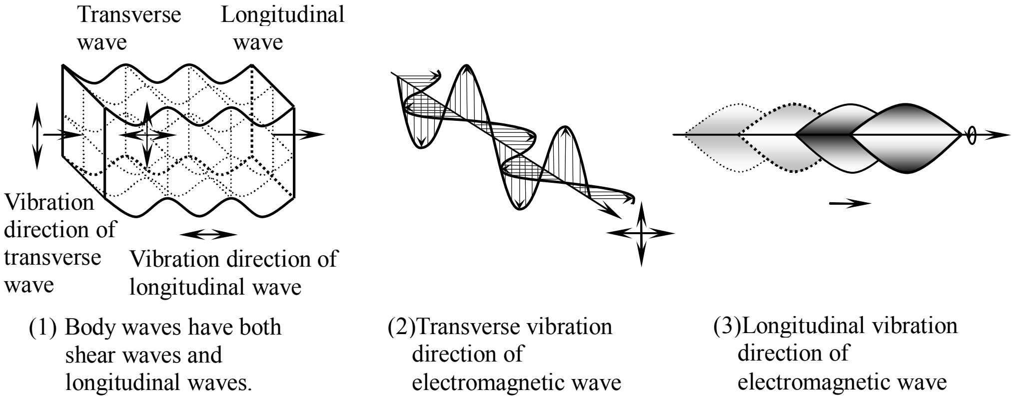


Figure 1: Vibration Direction of Body Wave and Electromagnetic Wave

When the electric field and magnetic field are alternately excited to form electromagnetic waves, the electric field waves and magnetic field waves vibrate simultaneously in the propagation direction and perpendicular to the propagation direction, and the electromagnetic waves have both transverse waves and longitudinal waves. According to the energy conservation of electric field and magnetic field when they are alternately excited, the phase difference between electric field wave and magnetic field wave is 90 degrees. As shown in Fig.1(2) and Fig.1(3).

Because the nature of light involves wave theory, the Maxwell's electromagnetic theory and quantum mechanics theory, the situation is complicated, so far the existing theories do not have a deep understanding of the nature of light. Here, only the conclusions of the author's new research are briefly introduced. The author will discuss the nature of light again in the subsequent articles on new quantum mechanics.

This theory can perfectly explain all the problems about light. In the following articles, the author will explain the zero results of the Michelson-Morey experiment, the orbit shape of binary stars, Sagnac effect and so on.

4. Wave is the Messenger that People Know Things

Some forms of waves can be sensed by human or animal senses or received by sensors of instruments. In fact, people receive, perceive and know distant things through waves as signals, and wave is the messenger that people know things. For example, listening to sounds with ears, seeing objects with eyes, feeling fluctuations with body, receiving sounds with microphone, detecting underwater terrain with sonar, observing human body with ultrasonic machine, **X** machine, **γ** machine, **CT** machine and **MRI** machine (nuclear magnetic resonance), taking photos with camera, shooting with video camera, detecting targets with radar, observing celestial bodies with optical telescope and radio telescope, and observing seismic waves with instruments. All these will eventually be converted into signals that can be perceived by human senses. All things that are perceived and observed in a non-contact way taking waves as messengers.

If the observer moves with the wave source (object), there is no distance and relative motion between them, and their motion states are exactly the same, so there is no need for a messenger at this time. In this case, the speed of the wave source (object) observed by the observer is the real moving speed of the wave source, which is called following observation. Otherwise, what is observed is not the real moving speed of the wave source (object).

When people study the laws of motion of objects, their distances are different. People can't move with distant objects, so they use electromagnetic waves (light waves) to illuminate objects, or use objects as wave sources to observe the movement of objects by receiving wave signals reflected or sent by them. Usually, objects emit light waves or reflect light waves. Observing the movement of objects through optical signals, most of the information received by human beings is to see the light wave signals emitted by objects with their eyes.

In this paper, linear waves are regarded as signals carrying information (such as sound waves, water waves and electromagnetic waves), and the propagation of linear waves in isotropic homogeneous media is analyzed to study the relation between waves and object motion. In the following, low-speed and intuitive sound waves or water waves will be taken as an example for analysis, and then extended to all waves including electromagnetic waves or light waves.

5. The Velocity of Waves Observed By A Moving Observer

Assuming that the wave source generates concentric circles water waves on the still water surface, the **UAV** as an observer flies close to the water surface at the speed V_o, and follows a certain peak to observe the speed of the water waves. We discuss the wave velocity observed by a moving observer in the x direction of Fig.2. There are four situations.

5.1 The observer's velocity is opposite to the wave velocity, as shown in point $\boldsymbol{A}$ on the left in Fig.2. When the observer hovers in air, the wave velocity observed by the observer is $\boldsymbol{c_w>0}$. When the observer's velocity is $\boldsymbol{V_o}$, the wave velocity observed by the observer is $\boldsymbol{c_w+V_o>0}$.

5.2 The observer's velocity is the same as the wave velocity, as shown in point $\boldsymbol{B}$ on the right in Fig.2. When the observer is always behind this peak, the observer's velocity is less than the wave velocity $\boldsymbol{V_o<c_w}$, and the wave velocity observed by the observer is $\boldsymbol{c_w-V_o>0}$;

5.3 The velocity of the observer is equal to the wave velocity $\boldsymbol{V_o=c_w}$, as shown in point $\boldsymbol{C}$ on the right in Fig.2, and the wave velocity observed by the observer is $\boldsymbol{c_w-V_o=0}$.

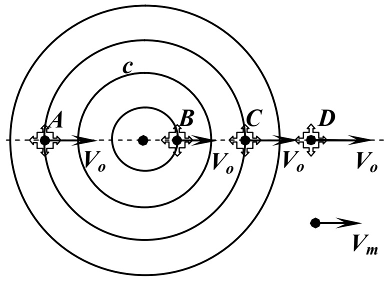


Figure 2: Velocity of Waves Observed By a Moving Observer

When the whole water flows uniformly at the speed $\boldsymbol{V_m}$, the concentric circles water waves generated on the water surface also flow uniformly with the water at the speed $\boldsymbol{V_m}$ without changing the shape. The wave velocity $\boldsymbol{c'_w}$ observed by the observer at any point is the difference between the wave velocity $\boldsymbol{c_w}$ in water and the vector of the observer velocity $\boldsymbol{V_o}$, and the sum of the vector of the overall moving velocity $\boldsymbol{V_m}$ of water:

$$\vec{c}'_w = \vec{c}_w - \vec{V}_o + \vec{V}_m \qquad (6)$$

The same is true of sound waves and electromagnetic waves (light waves), and this formula is suitable for all fluctuations.

6. The Derivations of Relativity and the General Superposition Formula of Wave Velocity

In Fig.3, the wave source moves in the $\boldsymbol{x}$ direction at the velocity $\boldsymbol{V_s}$, and the wave propagates in all directions at the velocity c_w. At every moment, the wave source is exciting spherical waves, forming a continuous spherical wave front, which spreads in all directions. Every position of the wave source in the process of movement constantly excites spherical waves, forming a continuous multi-wave front.

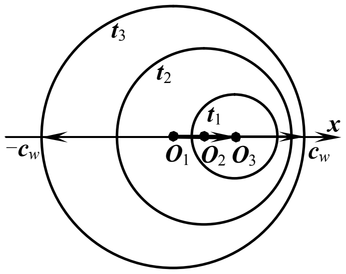


Figure 3: Propagation of Multi-Wave Front Generated By Wave Source Movement

Now consider the simple case of the wave source moving in the $\boldsymbol{x}$ direction. If the wave source is used as the reference system, observe the position of the multi-wave front in the $\boldsymbol{x}$ direction, and then observe the propagation speed of the multi-wave front. After time $\boldsymbol{t}$, in the positive direction of $\boldsymbol{x}$ axis , the wave source moves from point $\boldsymbol{O_1}$ to point $\boldsymbol{O_3}$, and the displacement of the wave source is $\boldsymbol{V_s t}$. The wave source has just generated a wave at this position, and the wavefront generated at time $\boldsymbol{t_0}$ propagates to the position of $\boldsymbol{c_w t}$.

The wave velocity observed by the observer with the wave source as the reference system is $\boldsymbol{c'_w=(c_w t-V_s t)/t=c_w-V_s}$. In the negative direction of $\boldsymbol{x}$ axis, the wave front generated at time $\boldsymbol{t_0}$ propagates to the position of $\boldsymbol{-c_w t}$, and the wave velocity observed by the observer with the wave source as the reference system is $\boldsymbol{c'_w=(-c_w t-V_s t)/t=-c_w-V_s}$. This accords with the relation of relative vector subtraction. In other directions, the wave velocity observed by the observer whose wave source is the reference frame conforms to the subtraction relationship of polygons of velocity vectors. That is, the wave velocity observed by the observer who takes the wave source as the reference system is

$$\vec{c}'_w = \vec{c}_w - \vec{V}_s \qquad (7)$$

If the observer's velocity relative to the wave source is $\boldsymbol{V_o}$, according to the relative vector subtraction relation of wave velocity, the above formula also subtracts the observer's velocity relative $\boldsymbol{V_o}$ to the wave source, and the formula (7) beomes

$$\vec{c}'_w = \vec{c}_w - \vec{V}_s - \vec{V}_o \qquad (8)$$

If the overall moving speed of a uniform medium is V_m, the medium drags the wave to move as a whole. According to the vector addition relation of wave velocity superposition, then the overall moving speed V_m of the medium is added, and the above formula becomes

$$\vec{c}'_w = \vec{c}_w - \vec{V}_s - \vec{V}_o + \vec{V}_m \tag{9}$$

If the observer is at rest, it means that the observer is moving in the opposite direction with respect to the light source at a speed of $-V_s$. According to the relative vector subtraction relation of wave velocity, this formula will also subtract the velocity of $-V_s$.

$$\vec{c}'_w = (\vec{c}_w - \vec{V}_s - \vec{V}_o + \vec{V}_m) - (-\vec{V}_s) \tag{10}$$
$$= \vec{c}_w - \vec{V}_o + \vec{V}_m$$

This calculation result shows that the speed of light observed by the observer is unchanged and has nothing to do with the moving velocity V_s of the light source (excluding V_s).

If the observer is moving at the speed V_m, the above formula becomes the general formula of wave velocity superposition:

$$\vec{c}'_w = \vec{c}_w - \vec{V}_o + \vec{V}_m \tag{6'}$$

For example, in the positive direction of x axis , the velocity of light seen by a stationary observer is $c'_w=(c_w-V_s)-(-V_s)=c_w$; In the negative direction of x axis, the velocity of light seen by a stationary observer is $c'_w=(-c_w-V_s)-(-V_s)=-c_w$.

This formula applies the above-mentioned laws of relativity and superposition of motion or wave velocity, and its velocity parameters include the vector subtraction relationship of wave velocity relativity and the vector addition relation of wave velocity superposition

7. Doppler Effect of Waves and Wave Barrier

When the wave source moves relative to the medium, the Doppler effect will occur. The point wave source generates spherical waves in the medium. If the wave source moves, it will squeeze the front wave on the front, shorten the wavelength and increase the frequency, resulting in blue shift. At the same time, the rear wavefront becomes sparse, the wavelength becomes longer and the frequency becomes lower, resulting in red shift.

Assuming that the observer is stationary and the wave source is moving, the observed results are as shown in Fig.4. There are four situations.

7.1 The wave source velocity is less than the wave velocity $V_s<c_w$, and the wave in front of it shifts blue and the frequency becomes higher. The deflected wave produces a red shift and the frequency becomes lower, as shown in Fig.4(1).

7.2 The velocity of wave source is equal to the wave velocity $V_s=c_w$, and the wave in front of it shifts blue and the frequency becomes higher. All wave fronts are crowded with the wave source at the front end, and the wave density reaches the maximum, resulting in wave barrier (sound barrier or light barrier) phenomenon. The frequency of redshift caused by the deviated wave becomes lower, only reaching half of the original frequency, as shown in Fig.4(2).

Suppose that an observer is stationary at the most right position in Fig.4(2), and the all wave fronts emitted by the wave source at each point propagate to this point at the same time. At this point, the observer can see the wave sources at all positions at the same time, and the apparent speed is infinite. That is to say, the wave source passes through various points, and continuous displacement $\Delta S \neq 0$ occurs. However, all waves observed by the observer arrive at the same time, that is $\Delta t=0$, so there is $V_a=\Delta S/\Delta t \rightarrow \infty$, and the speed of the wave source seen by the observer is infinite.

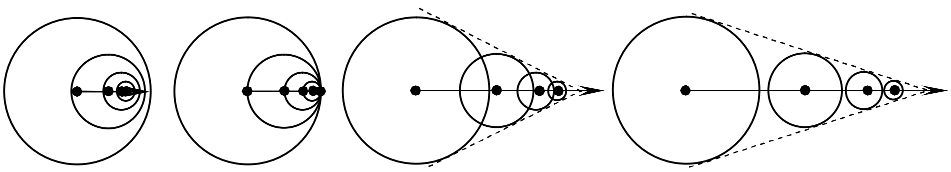
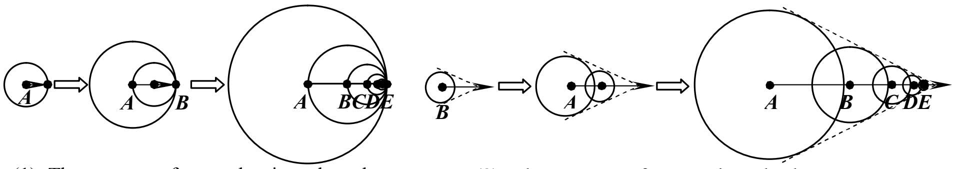


Figure 4: Doppler Effect of Wave and Shock Wave

7.3 The velocity of wave source is greater than the velocity of wave with $V_s>c_w$, and all the wave fronts are concentrated in the cone-shaped area at the back end, and the wave density is also very high. At every moment, the wave source surpasses the wave it produces. The phenomenon formed after wave source breaks through wave barrier is called shock wave (shock wave), as shown in Fig.4(3). At this time, the observer in the front of the wavefront observes that the apparent velocity of the wave source is negative. After the wave source crosses the wave barrier to form a shock wave, the observer with super-wave velocity in the front area of the shock wave cannot observe the wave signal.

7.4 When the velocity of wave source is much greater than the wave velocity $V_s>>c_w$, the density of the wave peak becomes very small, and each spherical wave has no intersection. At each moment, the wave source far exceeds the wave it generates, as shown in Fig.4 [4].



(1) The process of wave barrier when the speed of wave source reaches the wave speed.

(2) The process of generating shock wave when the velocity of wave source exceeds the wave velocity

Figure 5: Process of Generating Wave Barrier and Shock Wave

When the wave source is stationary and the observer is moving, the Doppler effect will also be observed. For example, people in moving vehicles hear the sound of stationary objects on the roadside. Wave speed can be surpassed, and super-wave speed is a very common phenomenon (including super-light speed).

When the wave source is moving, the waves generated at each position at each moment are independent and spread at the same speed. When the moving speed of the wave source reaches the wave speed, when the wave source moves from point ***A*** to point ***B***, the wave front generated at point ***A*** also propagates to point ***B***. At this moment, it can be considered that the wave source begins to generate another wave at point ***B*** (of course, the wave source is constantly generating a series of waves during the movement). The wave generated by the wave source at point ***B*** propagates around, and the wave generated at point ***A*** also propagates around at the same time.

When the wave generated at point ***B*** propagates to point A toward the left and also to point ***C*** toward the right, the wave generated at point ***A*** just propagates to point ***C***, they coincide each other. Therefore, each wavefront generated later passes through the center of the previous wavefront, and all the wavefronts are superimposed at the forefront to form a wave barrier, as shown in Fig.5 [1]. When the velocity of the wave source exceeds the wave velocity, each wavefront generated later will exceed the center of the previous wavefront to form a shock wave, as shown in Fig.5 [2].

8. The Observation Angle Effect of A Stationary Observer

8.1 Apparent Velocity

Zeng Jiqing introduced the concept of "the optical measurement speed of moving bodies" in [1], and thought that the error between the optical measurement speed of moving bodies and the actual velocity was related to the position of the observed object, which was an "observation position effect".

In this paper, the concept of "the optical measurement speed of moving bodies" in reference [1] and the characteristics of wave propagation are analyzed in depth. It is assumed that the wave source moves at the speed V_s and continuously emits spherical waves with the speed c_w. The distance between point A and point ***B*** is ***S***, and when the wave source moves from point ***A*** to point ***B*** at a constant speed, the observer ***C*** observes the wave signal, and the arc in the figure is the wave front. The distance between observer ***C*** and points ***A*** and ***B*** is S_A and S_B respectively, and the time of wave source at points ***A*** and ***B*** is ta and t_a+S/V_s respectively. Observer C detects the wave signal from point ***A*** at time t_a+S_A/c_w and the wave signal from point ***B*** at time $t_a+S/V_s+S_B/c_w$, as shown in Fig.6. Then the time interval for the waves at points ***A*** and ***B*** to propagate to point ***C*** is:

$$\Delta t = (t_a + \frac{S}{V_s} + \frac{S_B}{c_w}) - (t_a + \frac{S_A}{c_w}) \\ = \frac{S}{V_s} + \frac{S_B - S_A}{c_w} \tag{11}$$

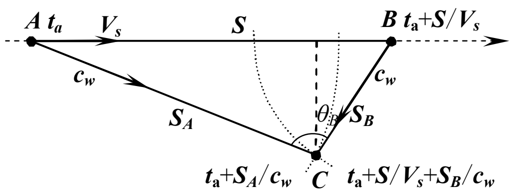


Figure 6: Apparent Velocity

If the observer moves with the object and follows the movement of the object, the result is the real movement. What is observed by other observation methods is not real, but distorted. Just like the "image" seen (observed), there are real images, virtual images, upright images, inverted images, enlarged images, reduced images, synchronous deformation images and distorted deformation images (haha mirror). Lorentz transformation is just a distorted deformation haha mirror.

Then, the distance **S** between points ***A*** and ***B***, the moving speed V_s, and the time t_a and t_a+S/V_s are the real moving conditions of the object.

If the wave signal detected by observer ***C*** is used as a means to observe the motion of an object, what we can actually observe is the wave signal emitted by the object. Because the wave propagation takes time, the time of detecting the wave signal that it sends out at two points, ***A*** and ***B***, and propagates to the observer's point ***C***, lags behind the actual time. The movement of the object obtained by this method is only the observation effect, not the real movement of the object.

The velocity of the detected object is calculated by the time interval between the waves emitted at points ***A*** and ***B*** and propagating to point ***C***. The velocity thus obtained is called apparent velocity V_a. In fact, observing the motion of an object in a non-contact way can only be observed through the wave signal emitted by the object, and only its apparent speed can be obtained.

According to Eq.(11), the apparent velocity of the object detected by the stationary observer ***C*** between points ***A*** and ***B*** is:

$$V_a = \frac{S}{\frac{S}{V_s} + \frac{S_B - S_A}{c_w}} = \frac{V_s}{1 + \frac{S_B - S_A}{S} \cdot \frac{V_s}{c_w}} \tag{12}$$

Assuming that the time for the wave source to move from point ***A*** to point ***B*** is $t_s = S/V_s$, the propagation time for the wave from ***A*** to ***C*** is $t_A = S_A/c_w$, and the propagation time for the wave from ***B*** to ***C*** is $t_B = S_B/c_w$, then Eq.(12) is:

$$V_a = \frac{V_s}{1 + \frac{t_B - t_A}{t_s}} \tag{13}$$

The wave source moves from point ***A*** with speed V_s and reaches point ***B*** after time S/V_s . If the apparent velocity is known as Va, the true moving velocity V_s of the wave source can be obtained from Eq. (12) as follows:

$$V_s = \frac{V_a}{1 - \frac{S_B - S_A}{S} \cdot \frac{V_a}{c_w}} \tag{14}$$

8.2 Apparent Velocity Observed In the Direction of Wave Source Motion

In the direction of wave source movement, the observer is at point ***A***, which is called the from rear observation, $S=SB$, $SA=0$, $SB-SA=S$, then Eq.(12) is:

$$V_a = \frac{V_s}{1 + \frac{V_s}{c_w}} = \frac{c_w V_s}{c_w + V_s} \tag{15}$$

In the direction of wave source movement, the observer is at point ***B***, which is called the from front observation, $S=S_A$, $S_B=0$, $S_B-S_A=-S$, then Eq.(12) is:

$$V_a = \frac{V_s}{1 - \frac{V_s}{c_w}} = \frac{c_w V_s}{c_w - V_s} \tag{15'}$$

If the observed apparent velocity V_a of the wave source is known, the real moving velocity V_s of the wave source can be obtained, and the inverse transformation Eq.(14) is as follows:
From rear observation:

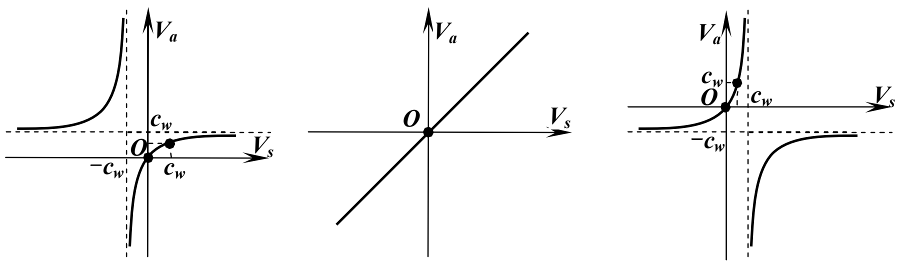
$$V_s = \frac{V_a}{1 - \frac{V_a}{c_w}} \tag{14'-1}$$

From front observation:

$$V_s = \frac{V_a}{1 + \frac{V_a}{c_w}} \tag{14'-2}$$

The images of Eq.(15) and (15') are shown in Fig.7, and each point in the image has a clear physical meaning. The range of motion velocity V_s and the apparent velocity V_a is -∞～+∞, and they both pass through the origin ***O***. The two asymptotes are $V_a = \pm c_w$ and $V_s = \pm c_w$, and the infinity point of the asymptote corresponds to the wave source velocity reaching the wave velocity $V_s = c_w$.

When the motion direction of the wave source is reversed, the positions of points ***A*** and ***B*** in Fig.7 are reversed, which means that both axes are reversed. That is, the left half axis of the image $-V_a = -V_s/(1+(-V_s)/c_w)$ shown in Fig.7(1) is transformed into the right half axis of the image $V_a = V_s/(1-V_s/c_w)$ (Fig.7(3)). Figs.7 (1) and 7(3) are centered on the origin ***O***, and have central symmetry, so it is only necessary to analyze the right semi-axis of the image.



(1) From rear observation $V_a = V_s/(1+V_s/c_w)$ (2) Tracking observation $V_a = V_s$ (3) From front observation $V_a = V_s/(1-V_s/c_w)$

Figure 7: Images of Apparent Velocity and Motion Velocity $V_a = V_s/(1 \pm V_s/c_w)$ In the Direction of Motion Velocity of Wave Source

In fact, if the wave source is moving, there are no fixed points ***A*** and ***B***. As long as the observer observes behind the wave source, it can be regarded as point ***A***, which is called from rear observation. As long as the observer observes in the front of the wave source, it can be regarded as point ***B***, which is called from front observation. As long as the observer moves with the wave source, it can be regarded as the midpoint, which is called follow observation.

8.2.1 When from rear observation, the observer is at point ***A*** at the wave source, and the apparent velocity of the wave source will not exceed the wave velocity $V_a<c_w$. When the velocity of the wave source reaches the wave velocity, $V_s=c_w$, and it can be known from Eq.(15) that its apparent velocity only reaches half of the wave velocity, and $V_a=c_w/2$. When the velocity of the wave source approaches infinity, $V_s\to\infty$. According to Eq.(14), its apparent velocity only approaches the wave velocity $V_a\to c_w$. Such as as shown in Fig.7(1).

8.2.2 When follow observation, the observer moves with the wave source, that is, its apparent speed is equal to the wave source's moving speed, and the observed speed is the real speed $V_a=V_s$, as shown in Fig.7(2).

8.2.3 When from front observation, the observer is at point ***B*** in front of the wave source, there are several situations. When the velocity of the wave source reaches half of the wave velocity, $V_s=c_w/2$, and it can be known from Eq.(15') that the apparent velocity can reach the wave velocity $V_a=c_w$. When the velocity of the wave source is in the range of $c_w/2<V_s<c_w$, it can be known from Eq.(15') that the apparent velocity will not be lower than the wave velocity $V_a>c_w$.

When the velocity of the wave source reaches the wave velocity, i.e., $V_s=c_w$, according to Eq.(15'), its apparent velocity can approach infinite $V_a\to\infty$, and the wave barrier will appear at this time. When the velocity of the wave source exceeds the wave velocity, $V_s>c_w$, according to Eq.(15'), its apparent velocity is negative and tends to negative infinity. As the velocity of wave source increases, its apparent velocity (absolute value) decreases, and shock wave phenomenon appears at this time.

When the velocity of the wave source is much greater than the wave velocity with $V_s>>c_w$, its apparent velocity is negative, and approaches the asymptote $V_a=-c_w$. Its apparent velocity (absolute value) will not be lower than the wave velocity, and it will smoothly approach the wave velocity $|V_a|\to c_w$. Such as Fig.7(3).

8.3 Apparent Velocity Observed In Other Directions of Wave Source Motion

When the wave source moves, it passes through each point in turn, and the constantly emitted spherical wave propagates to the observer ***C***. The viewing angles of the observer to each point are θ_A and θ_B respectively, as shown in Fig.6. When $\theta_A<\theta_B$, it is called the posterior observation; The moment when $\theta_A=\theta_B$, it is called the centered observation; when $\theta_A>\theta_B$, it is called the anterior observation. Let the distance from the observer to the moving direction of the wave source be d, then $S_A=d/\cos\theta_A$ and $S_B=d/\cos\theta_B$.

When the wave source moves from point ***A*** with speed V_s, there is actually no fixed point ***B***, and it reaches point ***B*** after time S/V_s. At this moment, the wavefront propagates to point ***C***, and the observer ***C*** at this moment just detects the wave signal sent by the wave source at point ***A***, so there is $S/V_s=S_A/c_w$. Substituting $S_A=Sc_w/V_s$ into Eq.(11), we can get the apparent velocity of the object detected by the observer ***C*** as follows:

$$V_a=\frac{S}{S_B}c_w=\frac{S_A}{S_B}V_s$$
$$=\frac{\cos\theta_A}{\cos\theta_B}V_s=\frac{S}{t_B}=\frac{t_A}{t_B}V_s \tag{16}$$

It can be seen that the apparent velocity of the observed wave source has nothing to do with the distance from the observer to the moving direction of the wave source, but only related to the observer's perspective. When the observers are in different positions and have the same viewing angle, the observed apparent velocities are all the same. If the wave source moves at a uniform speed, the apparent speed of the wave source observed by a stationary observer is non-uniform and variable. The ratio of apparent velocity to the motion velocity of wave source is equal to the ratio of cosine of observation angle. The observed apparent velocity is an observation angle effect. We call cosθB/cosθA as the observation angle effect factor, so the apparent velocity is equal to the moving velocity of the wave source multiplied by the observation angle effect factor.

When the wave source moves to points ***A*** and ***B***, the wave front of the emitted wave reaches the observer point ***C*** in turn. For the intersection of two arcs in Fig.7, the range of apparent velocity is between $V_s/(1+V_s/c_w)\le V_a\le V_s/(1-V_s/c_w)$. Its image is the area surrounded by the asymptote after the three images in Figure 7 are merged together, as shown in Fig.8.

8.3.1 For the posterior observation, $V_s/(1+V_s/c_w)\le V_a\le V_s\le c_w$, and the apparent velocity is less than the moving velocity of the wave source and less than the wave velocity;
8.3.2 For the centered observation, $V_a=V_s\le c_w$, and the apparent velocity is equal to the moving velocity of the wave source and less than or equal to the wave velocity;
8.3.3 For the anterior observation, $V_s\le V_a\le V_s/(1-V_s/c_w)$, and the apparent velocity is always greater than the moving velocity of the wave source. When the velocity of the wave source reaches the wave velocity, $V_s=c_w$, and the apparent velocity approaches infinite $V_a\to\infty$, wave barrier phenomenon appears at this time. When the velocity of wave source exceeds the wave velocity, $V_s>c_w$, and the apparent velocity is negative, $V_a<0$, then the shock wave phenomenon appears.

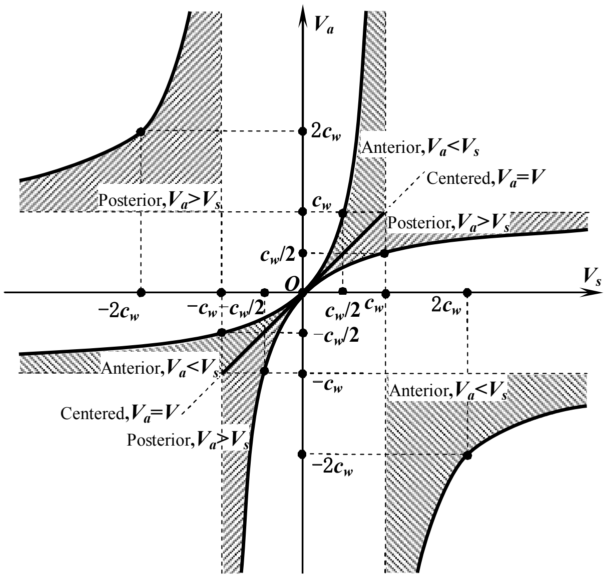


Figure 8: The Apparent Velocity of The Wave Source Observed In Other Directions of The Wave Source Movement Ranges Between $V_s/(1+V_s/c_w)<V_a<V_s/(1-V_s/c_w)$

9. Observation Angle Effect of Moving Observer

In the process of wave source moving from point A to point B with velocity V_s, the observer moves from point D to point E with velocity V_o in the same direction. The waves emitted by the wave source at points A and B continue to propagate after passing through points D and E, and intersect at point C, as shown in Fig.9.

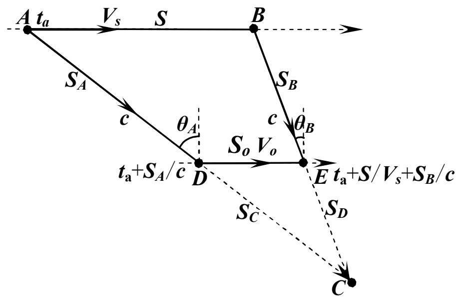


Figure 9: Observation Perspective Effect of Moving Observers

Let $AB=S$, $AD=S_A$, $BE=S_B$, $DE=S_o$, $DC=S_C$, $EC=S_D$, which can be obtained from the relation between $\triangle ABC$ and $\triangle DEC$ in similar triangles:

$$\frac{S}{S_o}=\frac{S_A+S_C}{S_C}=\frac{S_B+S_D}{S_D} \tag{17}$$

$$\frac{S_A}{S_B}=\frac{S_C}{S_D} \tag{18}$$

Take point C as the second observer, and point D also serves as the wave source, and observe the apparent velocities of points A and D of the moving wave source at point C. The apparent velocity of wave source A observed at point D is set as $V_{a(D\to A)}$. The apparent velocity of wave source A observed at point C is set as $V_{a(C\to A)}$, and the apparent velocity of wave source D observed at point C is set as $V_{a(C\to D)}$.

When the wave front from point A of the wave source propagates to point D of the moving observer, the observer just moves to point D. When the wave source moves to point B, the wave front from point A of the wave source propagates to point E, and the observer just moves to point E. The time interval between them is the same, that is, $\Delta t=S/V_s+(S_B-S_A)/c_w=S_o/V_o$, then the apparent velocity of wave source A observed by motion observer D is

$$V_{a(D\to A)}=\frac{S}{\frac{S}{V_s}+\frac{S_B-S_A}{c_w}}=\frac{S}{S_o}V_o \tag{19}$$

Combining Eqs.(11), (16), (17) and (18), the apparent velocity of wave source A observed at point D is

$$\begin{aligned}V_{a(D\to A)}&=\frac{S}{\frac{S}{V_s}+\frac{S_B-S_A}{c_w}}=\frac{V_s}{1+\frac{S_B-S_A}{S}\cdot\frac{V_s}{c_w}}\\&=\frac{S}{S_B}c_w=\frac{S_C}{S_D}V_s=\frac{S_A}{S_B}V_s=\frac{S}{S_o}V_o=\frac{\cos\theta_B}{\cos\theta_A}V_s\end{aligned} \tag{20}$$

The apparent velocity of wave source A observed at point C is

$$V_{a(C\to A)}=\frac{S}{\frac{S}{V_s}+\frac{S_B+S_D-S_A-S_C}{c_w}}$$

$$=\frac{V_s}{1+\frac{S_B+S_D-S_A-S_C}{S}\cdot\frac{V_s}{c_w}}$$

$$=\frac{c_w S}{S_B+S_D}=\frac{V_s(S_A+S_C)}{S_B+S_D} \qquad (21)$$

$$=\frac{S_C}{S_D}V_s=\frac{S_A}{S_B}V_s=\frac{S}{S_o}V_o$$

$$=\frac{\cos\theta_B}{\cos\theta_A}V_s$$

$$=V_{a(D\to A)}$$

The apparent velocity of observer ***D*** observed at point ***C*** is

$$V_{a(C\to D)}=\frac{S_o}{\frac{S_o}{V_o}+\frac{S_D-S_C}{c_w}}$$

$$=\frac{V_o}{1+\frac{S_D-S_C}{S_o}\cdot\frac{V_o}{c_w}}$$

$$=\frac{S_o}{S_D}c_w=\frac{S_C}{S_D}V_o=\frac{S_A}{S_B}V_o \qquad (22)$$

$$=\frac{\cos\theta_B}{\cos\theta_A}V_o$$

Can be obtained from Eqs.(19), (20), (21) and (22):

$$\frac{S_A}{S_B}=\frac{S_C}{S_D}=\frac{V_{a(C\to A)}}{V_s}=\frac{V_{a(C\to D)}}{V_o} \qquad (23)$$

$$V'_a=V_{a(C\to A)}-V_{a(C\to D)}$$

$$=\frac{S_A}{S_B}(V_s-V_o)=\frac{\cos\theta_B}{\cos\theta_A}(V_s-V_o) \qquad (24)$$

$$\frac{V_{a(D\to A)}}{V_{a(C\to D)}}=\frac{V_s}{V_o}=\frac{\cos\theta_B}{\cos\theta_A} \qquad (25)$$

Eq.(21) also shows that the apparent velocities of wave sources observed by observers at the same visual angle are all the same, regardless of the observation distance.

Eq.(24) is the apparent velocity of the wave source relative to the moving observer, that is, the relative apparent velocity between the wave source and the observer. The apparent velocity of the wave source observed by the moving observer and the stationary observer is equal to the relative vector subtraction relation of the velocity, and then multiplied by the observation angle effect factor. Its image is equivalent to shift a value V_o for Fig.7 and Fig.8 mentioned above, and the figure is omitted.

If the positions of the wave source and the observer are reversed, the observed apparent velocities are equal in magnitude and opposite in direction because of the same viewing angle. Namely:

$$V_{a(D\to A)}=-V_{a(A\to D)} \qquad (26)$$

If the observer's moving direction is arbitrary and has an angle $\boldsymbol{\alpha}$ with the moving direction of the wave source, the observed apparent velocity is calculated by taking the velocity component $\boldsymbol{V_o\cos\alpha}$ in the moving direction of the wave source, while the velocity component $\boldsymbol{V_o\sin\alpha}$ in the vertical direction has no influence on the observed apparent velocity, then Eqs.(24) and (25) are respectively:

$$V'_a=V_{a(C\to A)}-V_{a(C\to D)}=(V_s-V_o\cos\alpha)\cdot\frac{\cos\theta_B}{\cos\theta_A} \qquad (27)$$

$$\frac{V_{a(D\to A)}}{V_{a(C\to D)}}=\frac{V_s}{V_o\cos\alpha}=\frac{\cos\theta_B}{\cos\theta_A} \qquad (28)$$

It can be seen that the apparent velocity observed by the moving observer is also an observation angle effect. The apparent velocity of the wave source observed by the moving observer is equal to the apparent velocity of the moving observer multiplied by the angle effect factor $\boldsymbol{\cos\theta_B/\cos\theta_A}$. It is the same as the apparent speed observed by the above-mentioned static observer.

As can be seen from the Eq.(24):

9.1 When the observer is stationary with V_o=0, or when the observer's moving speed is much less than that of the wave source $\boldsymbol{V_o<<V_s}$, the apparent speed of the wave source is observed as $\boldsymbol{V_{a(C\to A)}=V_s\cos\theta_B/\cos\theta_A}$, which is the observation angle effect of the static observer in the previous section.

9.2 When the speed of the moving observer is less than the moving speed of the wave source $\boldsymbol{0<V_o<V_s}$, the observed apparent speed of the wave source is less than the observed apparent speed of the wave source $\boldsymbol{V'_a<V_a}$ when the observer is stationary.

9.3 When the velocity of the moving observer is equal to the velocity of the wave source, $\boldsymbol{V_o=V_s}$ then $\boldsymbol{V'_a=V_{a(C\to A)}-V_{a(C\to D)}=0,}$ and their apparent velocities are equal to $\boldsymbol{V_{a(C\to A)}=V_{a(C\to D)}}$. They are relatively static, and the relative apparent velocity is zero, $\boldsymbol{V'_a=0,}$ at this time, the apparent velocity of the wave source observed by the motion observer is the real motion velocity of the wave source, although there is a long distance between the observer and the wave source, it also belongs to a follow-up observation. When the observer's velocity is greater than that of the wave source, $V_o>V_s$, then the apparent velocity direction of the wave source is observed to be opposite to $\boldsymbol{V'_a<0}$.

9.4 When the observer is stationary, $\boldsymbol{V_o=0}$, then the relative apparent velocity of the wave source is $\boldsymbol{V'_a=V_s\cos\theta_B/\cos\theta_A=V_a,}$ which is Eq.(16), and the relative apparent velocity of the wave source becomes the apparent velocity of the wave source.

9.5 When the wave source is stationary, $\boldsymbol{V_s=0,}$ then the relative apparent velocity of the wave source is $\boldsymbol{V'_a=-V_o\cos\theta_B/\cos\theta_A}$, and the relative apparent velocity of the wave source is opposite to that of the wave source.

9.6 When the observer and the wave source move in the same straight line, then $\boldsymbol{\cos\theta_B=\cos\theta_A=1,}$ and the relative apparent velocity between the wave source and the observer is $\boldsymbol{V'_a=V_{a(C\to A)}-}$

$V_{a(C \to D)} = V_s - V_o$, which is the relative motion relation, that is, the relative vector subtraction relation between the observer velocity and the wave source velocity:

$$\vec{V}'_a = \vec{V}_s - \vec{V}_o \tag{29}$$

9.7 It can be seen from the Eq.(25) that the ratio of the apparent velocity of the moving wave source and the apparent velocity of the moving observer is equal to the ratio of their moving velocities and also equal to the observation angle effect factor.

9.8 Given the observer's motion velocity V_o, if the observed relative apparent velocity V'_a of the wave source and the observation angles θ_0 and θ_B are measured, the true motion velocity V_s of the wave source can be obtained by the inverse transformation of Eq.(24):

$$V_s = V_o + V'_a \cdot \frac{\cos\theta_A}{\cos\theta_B} \tag{30}$$

10. The Problem of Non-simultaneity of Time Sequence Inversion of Observation Visual Angle

When the moving velocity of the wave source is greater than the wave velocity, from front and anterior observation, the wave signal sent by the wave source when it reaches the end point is received first, and the wave signal sent by the wave source when it starts is received later, the observation time sequence is inverted, and the apparent velocity of the wave source is observed to be negative. However, this phenomenon of time sequence inversion is only the observation perspective effect when waves are used as messengers, rather than the real time sequence inversion.

After the bullet flew to the target, the gunfire spread to people's ears; after the supersonic plane flew to its destination, the sound had not yet reached; the speedboat has already landed, but the water waves from the starting point can't spread to the shore. These are common phenomena.

There are many objects in the actual scene, and when they are still, many wave signals (such as light wave signals) are constantly emitted all the time. It takes time for these wave signals to travel to the observer, and only objects with the same distance from the observer can send out wave signals at the same time to reach the observer. However, the wave signals emitted by objects with unequal distances from the observer do not reach the observer at the same time.

All the scenes are seen at the same time, but only the light emitted by those scenes at the same distance from us is emitted at the same time, the scenes we see at the same time are far and near, and all of them don't emit light at the same time.

When an object is moving, it constantly sends out wave signals, and the wave signals sent out at each moment are independent of each other. These wave signals have different distances and different time to travel to the stationary observer in turn, and the observed wave signals are not sent out at the same time.

Many objects move at the same speed and direction, and their wave signals are transmitted to the stationary observer in turn. Only those objects that are at the same distance from the observer and send out wave signals at the same time can reach the observer at the same time. However, for those objects with unequal distances from the observer, the wave signals emitted at the same time do not reach the observer at the same time.

Any event that happens will spread optical signals in the form of light waves, so that we can see the occurrence of the events. We see events happening at the same time, but in fact, all events are not necessarily happening at the same time. The distance between the observer and the event is different, and the light emitted by the event enters the observer's eyes at the same time, and the event is seen to happen at the same time, but the real event does not happen at the same time. The world that we hear with our ears, see with our eyes and detect with instruments is not the real world, but only the observation angle effect.

11. Examples of Superwave Velocity Phenomenon

It is a common phenomenon that an object that produces water waves and sound waves moves at the propagation speed of water waves and sound waves, and it is also a common phenomenon to move beyond the propagation speed of water waves and sound waves. Cherenkov radiation [2], which often occurs in nuclear reaction devices, means that the speed of high-energy electrons moving in water exceeds the propagation speed of light in water. Many discoveries have been made about the light source moving at the speed of light, even at superluminal speed, such as neutrino superluminal phenomenon [3-5] and quasar superluminal phenomenon [6-8]. Although there are a lot of researches in this field [6-11], a convincing physical explanation has never been given [3].

These phenomena can be well explained by the theory in this paper. The velocity of high-energy electrons radiated by Cherenkov definitely exceeds the propagation velocity of light in water, which is the same as that of ships sailing in water, so I will not explain it in detail here. The superluminal phenomenon of quasars is explained by taking light waves as an example. When observing celestial bodies on the earth, they move in complex directions at various speeds. It is impossible for observers on the earth to follow these celestial bodies, and it is impossible for the earth to move in the same direction with the celestial bodies at the same speed, so it is impossible to observe the real speed of the celestial bodies, only the apparent speed of the celestial bodies. Observing the movement of celestial bodies away from the earth is to observe from behind or from behind. It can be seen from Fig.7(1) and Fig.8 that even if the real moving speed of celestial bodies reaches the speed of light or even superluminal, the observed apparent speed is less than the real moving speed of celestial bodies and will not exceed the speed of light, but this does not exclude that the real moving speed of celestial bodies exceeds the speed of light.

Only when the celestial body moves towards the earth, that is, when it is observed from the front or from the front, it can be seen from Fig.7(3) and Fig.8 that the observed apparent velocity can be greater than the real motion velocity of the celestial body. When the speed of celestial body moving towards the earth is less than the speed of light, the observed apparent speed is greater than the real speed of celestial body. When the real speed of celestial body reaches half the speed of light, the observed apparent speed can reach the speed of light. If only the apparent speed of celestial bodies is observed to exceed the speed of light, it does not mean that the real speed of celestial bodies exceeds the speed of light.

When the celestial body moves in the direction of the earth, the observed apparent speed approaches infinity when the real moving speed of the celestial body reaches the speed of light, and the phenomenon of light barrier occurs at this time. When the real motion speed of celestial bodies exceeds the speed of light, celestial bodies break through the light barrier and produce a shock wave of light. Only when the light barrier phenomenon of celestial bodies is observed can the real motion speed of celestial bodies reach the speed of light. Only when the shock wave phenomenon of celestial light is observed can the real motion speed of celestial bodies exceed the speed of light. When the earth's moving speed is far less than that of the giant celestial body, it can be seen from Eq.(27) that the observed apparent speed of the giant celestial body is also far less than its real moving speed.

As for the superluminal phenomenon of quasars, only the superluminal phenomenon of apparent velocity has been observed, and whether its real moving speed exceeds the speed of light can be determined only after further observation on whether quasars have light barrier phenomenon or light shock wave phenomenon.

12. Technical Application of Observation Angle Effect

According to the inverse transformation Eqs.(14'-1), (14'-2) or (30), we design the module of electronic circuit or program, and add it to the above-mentioned various devices, convert the observed apparent velocity V_a of the wave source into processable electrical information, and input it into the module. After electronic circuit processing or program calculation, output the real motion velocity V_s of the wave source, which is the real motion velocity of the observed object, as shown in Fig.10. Its technical application prospect is very broad.

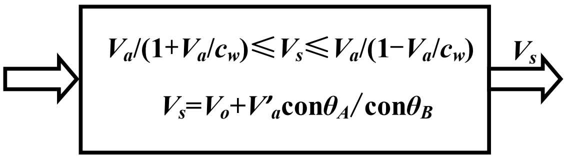


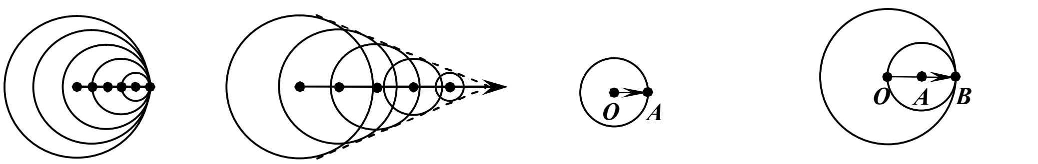
Figure 10: Real Motion Speed-Apparent Speed Conversion Module

Appendix: The schematic diagrams of sound barrier and shock wave in relevant materials are all wrong

The schematic diagrams of sound barrier and shock wave as shown in Appendix Diagrams (1) and (2) in the related data are all wrong. Figs.4(2) and 4(3) in this paper are correct [12]. The analysis is as follows.

When the wave source moves, the waves generated at each position at each moment are independent and spread at the same speed. When the wave source moves from point O to point A at the speed of wave, the wave front generated at point O also propagates to point A, and at this moment, the wave source starts to generate another wave at point A (of course, the wave source is constantly generating a series of waves during the movement), as shown in Appendix Diagram (3). The wave generated by the wave source at point A propagates around, and the wave generated at point O also propagates around at the same time at the same speed.

When the wave generated at point A propagates to point O to the left, it also propagates to point B, and the wave generated at point O just propagates to point B to coincide. In this way, the wave fronts of a series of waves continuously generated by the wave source during the movement are all overlapped at the wave source, forming a wave barrier, as shown in Appendix Diagram (4). In the schematic diagram of wave barrier, each back circle passes through the center of the front circle, which is Figure 4(2) of this paper. In the shock wave diagram, each back circle exceeds the center of the front circle, which is Figure 4(3) of this paper.



(1)Schematic diagram of sound barrier in data

(2)Schematic diagram of shock wave in data

(3)The process of wave barrier when the speed of wave source reaches the wave speed.

(4)The process of wave barrier when the speed of wave source reaches the wave speed.

Figure 11: Appendix Diagram of Wave Barrier

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