Fundamental Principles of Physics

Hongyuan Ye*

Yangtze River Delta Innovation Lab (Jiashan), Zhejiang, China

[Abstract] This paper inherits and develops Newton's dialectical space-time concept. Physical matter is an objective existence with energy. Moreover, physical matter can be divided into solid matter and field matter. Vacuum space is the absolute space, and the speed of field matter in vacuum is a constant C. In this paper, general mass is introduced and defined based on energy. For any physical matter with energy E, its general mass is defined as $m_E = E/C^2$. The introduction of general mass extends Newton's classical dynamics from solid matter to field matter and Newton's classical law of gravitation to the law of general gravitation, which replaces Einstein's special and general relativity. Furthermore, a verification experiment of the law of general gravitation is presented in this paper. When the light is far from the sun's atmosphere and $R = 200R_0$, the light deflection angle $\Delta\theta$ is 0.004367″. Regarding standard cosmology problems, the general mass of field matter is the so-called dark matter, and the energy of field matter is the so-called dark energy. The universe expands uniformly around the void space at the field speed C, with the expansion of galaxies accelerating. The estimated values of the general mass and energy of the field matter are approximately consistent with the modern cosmic observation data. Energy is the essence of physical matter, and inertia, gravitation, space and motion characteristics are the universal fundamental properties of energy, and Inertial mass, gravitational mass, time and temperature are the measurements of the properties of energy.

[Keywords] physical absolute space, void space, physical matter, energy, solid matter, field matter, general mass, law of gravitation, law of general gravitation, standard cosmology, dark matter, dark energy, cosmic expansion.

1. Introduction

At the end of the 19th century and the beginning of the 20th century, people believed that physics had been developed based on Newton's concepts of space-time and mechanics. However, there are two issues with these concepts. One is the explanation of blackbody radiation, which later led to the discovery of quantum mechanics. Another issue is the Michelson-Morey experiment that caused the "Ether" crisis, which led to the proposition of the principle of relativity and the assumption that the speed of light in a vacuum is constant, which gave birth to the theory of relativity. Relativity only recognizes relative space-time, which cannot explain the absoluteness of the conservation of energy. Regarding the development of modern cosmic observation, general relativity cannot answer many questions, such as dark matter, dark energy and the accelerated expansion of the universe.

Maxwell's equations provide an important theoretical basis for modern physics. However, recent studies[1] have proven that two of the four Maxwell's equations are wrong. A changing electric field in a vacuum cannot excite a magnetic field, and a changing magnetic field cannot excite an electric field. "Electromagnetic waves" do not exist in the physical world. Light is not an "electromagnetic wave". As a result, the study of modern physics needs to be significantly

revised.

2. Space and time

2.1 Mathematical space and time

Definition 2.1 Mathematical absolute space is defined as a three-dimensional Cartesian coordinate system: three number axes intersect at the origin O and are perpendicular to each other. These three number axes are called the X-axis (horizontal axis), Y-axis (longitudinal axis) and Z-axis (vertical axis). The three coordinate axes conform to the right-hand rule, that is, the Z-axis is held with the right hand, and the four fingers of the right hand turn from the positive X-axis to the positive Y-axis; the direction of the thumb is the positive direction of the Z-axis. The three coordinate axes are linear coordinate axes, which are uniform everywhere and extend infinitely. Each point on the coordinate axis corresponds to a real number. Mathematical absolute space is static and invariable.

Definition 2.2 Mathematical relative space is a limited local area of the mathematical absolute space, and it is dynamically variable. The mathematical relative space can be a linear three-dimensional Cartesian coordinate system or a nonlinear mathematical coordinate system. Any point in the mathematical relative space has a one-to-one correspondence point in the mathematical absolute space.

Definition 2.3 Mathematical absolute time is a one-dimensional coordinate axis. A point is selected on the coordinate axis to be the origin O, and the right direction of the point is the positive direction. The one-dimensional coordinate axis is a linear coordinate axis, which is uniform everywhere and extends infinitely. Each point on the coordinate axis corresponds to a real number.

Definition 2.4 Mathematical relative time is a limited local area of the mathematical absolute time. The mathematical relative time is a one-dimensional linear coordinate axis or a one-dimensional nonlinear coordinate axis. Any point in the mathematical relative time has a one-to-one correspondence point in the mathematical absolute time.

The mathematical absolute space and time are a congenital framework for us to understand the world. They are absolutely invariable and static and do not interact with anything outside. The mathematical relative space and time are the limited local areas of the mathematical absolute space and time, which are dynamically variable and related to external things.

2.2 Physical space and time

Axiom 2.1 Physical absolute space is a three-dimensional infinite linear space that has no

directionality and is uniform and isotropic everywhere. The physical absolute space is absolutely invariable and static and has nothing to do with anything outside; it is independent of the creation, change and extinction of the universe. With the above characteristics, the physical absolute space can be described through mathematical absolute space: three-dimensional Cartesian coordinate system.

Physical absolute space is the container where all physical matters exist. Physical absolute space itself does not interact with any specific physical matter and energy. It is an absolute vacuum space and can be called a void space.

Although we cannot fully prove the existence of the physical absolute space, based on our knowledge of the limited local physical world, the physical absolute space is real and conforms to our perceptual a priori. In the past half century, with the expansion and deepening of our exploration of the universe, the physical absolute space can help us to better understand the creation, change and extinction of the universe. The universe is synonymous to a changing water drop in the physical absolute space.

Definition 2.5 Physical relative space is a limited local area of the physical absolute space. The physical relative space is generally associated with a specific physical matter to better describe the characteristics of this physical matter. Physical relative space is dynamically variable.

Physical relative space can be linear or nonlinear. It may be three-dimensional or not. Any point in the physical relative space has a one-to-one correspondence point in the physical absolute space. With the above characteristics, the physical relative space can be described by the mathematical relative space.

Definition 2.6 Physical absolute time is a one-dimensional linear coordinate axis. It flows uniformly and has nothing to do with anything outside. Moreover, it is independent of the creation, change and extinction of the universe. With the above characteristics, the physical absolute time can be described by mathematical absolute time, i.e., the one-dimensional Cartesian coordinate axis.

The physical absolute time is the measurement of the properties of physical matter moving and changing in space.

Definition 2.7 Physical relative time is a limited local area of the physical absolute time. It is generally associated with the specific moving physical matter to better describe the characteristics of this physical matter.

The physical relative time is a one-dimensional linear or nonlinear coordinate axis. Any point

in the physical relative time has a one-to-one correspondence point in the physical absolute time. With the above characteristics, the physical relative time can be described by the mathematical relative time.

Physical matter is an objective existence of physical energy. Physical space and time are the objective existence of physics, but they are not the objective existence of physical energy. Therefore, physical space and time are not physical matter, but universal attributes of physical matter.

Physical space and time are the objective existence of physics, and mathematical space and time are the linguistic description and objective reflection of physical space and time.

Absolute space and time reflect the universality, consistency and stability of the physical matter, while relative space and time reflect the particularity, diversity and movement characteristics of the specific physical matter.

The above discussion on space and time is obtained through the inheritance and development of Newton's dialectical space-time. Einstein's relative space-time regards physical space and time as the essence of the specific physical matter, only recognizes the existence of the relative space-time and denies absolute space-time.

The theory of special relativity is based on the principle of relativity and the principle of light speed invariance. In fact, there are no two inertial reference frames with relative motion in the physical world, and the vacuum contained therein is independent of each other. Contrary to air, a vacuum cannot be placed in a sealed container and cannot move with the inertial system. Thus, the principle of relativity does not hold when a vacuum is involved. On the other hand, the vacuums of all inertial systems are inseparable. Vacuums have the characteristics of absolute space, so the principle of light speed invariance in vacuums must be true. Regarding special relativity, another paper will be developed based on experiments.

3. Physical matter

In philosophy, we define matter as an objective existence. Thus, we can define physical matter as an objective existence with energy. Physical matter can be further divided into solid matter and field matter. Solid matter includes various forms of macro-objects and all micro-particles and elementary particles. The velocity of solid matter is less than C, and it shows more particle characteristics. There are only four kinds of field matter: the electric field, magnetic field, light field and gravitational field. Field matter can only move in the physical absolute space, so its speed is a constant C, which is reasonable and self-consistent. Both solid matter and field matter have energy.

3.1 Energy and mass

Physical matter is an objective existence of energy. Energy is the essence of physical matter. Both solid matter and field matter have energy, and energy conservation is the most fundamental law of physics.

According to classical physics, mass refers to the amount of matter contained in an object. Solid matter has inertial mass and gravitational mass. The mass represented by Newton's second law is called inertial mass, and the mass represented by the law of gravitation is called gravitational mass. Inertial mass and gravitational mass are equal.

According to Einstein's mass energy equation, for a solid matter with mass m_E, its energy is

$$E = m_E C^2 \qquad (3\text{-}1)$$

Energy is a more fundamental physical quantity than mass. In contrast to the definition of mass in classical physics, we define mass based on energy and solid matter. For the solid matter with energy E, its mass m_E is defined as

$$m_E = E / C^2 \qquad (3\text{-}2)$$

According to the above definition, in an independent physical system, if there is only solid matter, energy is conserved, and mass must be conserved.

The field matter has field quantum properties. The field quantum is the smallest unit of fields. The field quantum of electric fields is the electric field quantum; the field quantum of magnetic fields is the magnetic field quantum; the field quantum of light fields is the quantum of the light field, i.e., photons; and the field quantum of the gravitational field is the quantum of the gravitational field. The velocity of the field matter is a constant C, and its energy is as follows:

$$E = h\gamma \qquad (3\text{-}3)$$

According to classical and modern physics, field matter also has the energy of solid matter, and its energy is conserved. However, the traditional definition of the mass of solid matter cannot be extended to field matter.

Formula (3-2) (mass definition) is based on energy, and can be easily extended to field matter. The definition of the mass of field matter is as follows: For field matter with the energy E, its mass is defined as:

$$m_E = E / C^2 \qquad (3\text{-}4)$$

The energy of the field matter is $E = h\gamma$; then, the mass of the field matter is

$$m_E = h\gamma / C^2 \qquad (3\text{-}5)$$

Formula (3-5) defines the mass of the field matter. The velocity of the field matter is equal to the field velocity C. The force applied to the field matter will not produce acceleration and deceleration but will change the energy and momentum.

Based on the above mass definitions of solid matter and field matter, we can obtain a **general**

mass definition of matter. For any physical matter with energy E, its general mass is defined as

$$m_E = E/C^2 \quad (3\text{-}6)$$

Based on the above definition of general mass, in an independent physical system, energy is conserved, and the general mass must also be conserved.

For a solid matter, its energy includes three parts: the static mass at absolute zero, kinetic energy and thermal energy. Then, the total energy of the solid matter is:

$$E = m_0C^2 + K(v, t)\, m_0 \quad (3\text{-}7)$$

where the coefficient K (v, t) is a function of the velocity v and the temperature t of the solid matter.

The general mass of the solid matter is

$$m = m_0 + K(v, t)\, m_0/C^2 \quad (3\text{-}8)$$

According to Formula (3-8), the general mass of the solid matter is variable. The higher the speed and temperature are, the greater the general mass of the solid matter is.

The coefficient K (v, t) is a function of v and t and will be discussed in another paper.

3.2 Newton's second law and momentum law

Solid matter satisfies Newton's second law

$$\mathbf{F} = m_E\mathbf{a} \quad (3\text{-}9)$$

where m_E is the general mass of the solid matter, and **a** is its acceleration.

The velocity of the field matter is a constant C, and the field matter has no acceleration. Therefore, Newton's second law (Formula (3-9)) does not hold for the field matter.

Acceleration can be expressed as the differential of the velocity, so Newton's second law (Formula (3-9)) can be expressed as:

$$\mathbf{F} = m_E\, d\mathbf{v}/\, dt$$

Then,

$$\mathbf{F} = d(m_E\mathbf{v})/\, dt \quad (3\text{-}10)$$

where the momentum is $p = m_E\mathbf{v}$. For solid matter, Newton's second law is equivalent to the momentum theorem. The momentum theorem (Formula (3-10)) can be expressed as:

$$\mathbf{F} \cdot dt = d(m_E\mathbf{v}) \quad (3\text{-}11)$$

or

$$\mathbf{F} \cdot dt = d\mathbf{p} \quad (3\text{-}12)$$

Regarding solid matter, its general mass is unchanged (strictly speaking, the general mass of the solid matter changes slightly with the change in its velocity and temperature), and the

impulse will change the velocity of the solid matter.

For a field matter, the velocity of the field is a constant C, and the impulse will change the general mass of the field matter.

Energy and momentum are the two most fundamental physical quantities. Energy conservation and momentum conservation are the two most fundamental laws of physics, which hold true for both solid matter and field matter.

4. Law of general gravitation

4.1 Law of gravitation

In 1687, Newton, who was the greatest physicist, discovered the law of gravitation based on the research results of scientific pioneers such as Copernicus, Galileo and Kepler. Any two objects have gravitational force, and the magnitude of the gravitational force is proportional to the product of the masses of the two objects and inversely proportional to the square of their distance. The formula is:

$$\mathbf{F} = G\, m_1\, m_2 / r^2 \qquad (4\text{-}1)$$

The above formula is used for solid matter, where **F** is the gravitational force of the two solid materials; m_1 and m_2 are the masses of the two solid materials; r is the distance between the two solid materials; and G is the gravitational constant, $G = 6.67 \times 10^{-11} N \cdot m / kg^2$.

4.2 Law of general gravitation

Formula (3-6) defines the general mass of physical matter based on energy. There is a general mass in both solid matter and field matter. Based on the general mass, Newton's law of gravitation can be extended to the law of general gravitation. Any two physical matters have gravitational force, and the magnitude of the gravitational force is proportional to the product of the general masses of the two physical matters and inversely proportional to the square of their distance. The formula is:

$$\mathbf{F} = G\, m_{E1}\, m_{E2} / r^2 \qquad (4\text{-}2)$$

where m_{E1} and m_{E1} are the general mass of two physical matters; and $m_{E1} = E_1 / C^2$; and $m_{E1} = E_2 / C^2$.

Substituting the general mass $m_{E1} = E_1 / C^2$ and $m_{E1} = E_2 / C^2$ into Formula (4-2), then

$$\mathbf{F} = G\,(E_1 / C^2)(E_2 / C^2) / r^2$$

$$\mathbf{F} = (G/C^4)\, E_1\, E_2 / r^2$$

Letting $G_E = G / C^4$ gives $G_E = 8.23 \times 10^{-45}\ N \cdot m / J^2$, which is the general gravitational constant; then,

$$\mathbf{F} = G_E\, E_1\, E_2 / r^2 \qquad (4\text{-}3)$$

Formula (4-3) is the law of general gravitation based on energy. Any two physical matters have gravitational force, and the magnitude of the gravitational force is proportional to the product of the energy of the two physical matters and inversely proportional to the square of their distance.

From Formula (4-3), we let **D** = **F**/E_2; and we define it as follows:

$$\mathbf{D} = G_E E_1 / r^2 \qquad (4\text{-}4)$$

D is the strength of the gravitational field of the energy E_1 at the distance r.

In summary, physical matter is an objective existence with energy. Energy is the essence of physical matter. Inertia and the gravitational characteristics are the universal properties of energy. Inertial mass is the measurement of the energy inertial property, and gravitational mass is the measurement of the energy gravitational property. The gravitational constant G causes the gravitational mass and inertial mass to be equal, and the gravitational mass and inertial mass can be unified into a general mass.

4.3 Verification experiment of the law of general gravitation

When Einstein published the theory of general relativity in 1915, he proposed three key verification experiments:

- Deflection angle of light in a gravitational field.
- Mercury perihelion advance.
- Gravitational redshift.

Below, we will calculate the deflection angle of light passing through the sun based on the law of general gravitation.

4.3.1 Perihelion deflection angle of light

Photons have a general mass m_E. Based on the law of general gravitation, when photons pass through the sun, the photons will deflect under the gravitational action of the sun.

The general mass of the sun is $M_E = 1.989\text{x}10^{30}$ kg, and its radius is $R_0=6.955\text{x}10^8$ m.

Without losing generality, we let the wavelength of light be λ= 570 nm and the frequency be γ= $5.26\text{x}10^{14}$ Hz. Thus, the photon energy is:

$$E_\gamma = h\gamma$$
$$=6.626\text{x}10^{-34} \text{ x } 5.26\text{x}10^{14}$$
$$= 3.487 \text{ x } 10^{-19} \text{ J}$$

Its general mess:

$$m_E = E_\gamma / C^2$$
$$= (3.487 \text{ x } 10^{-19}) / (3.0 \text{ x } 10^8)^2$$
$$=3.874\text{x}10^{-36} \text{ kg}$$

The momentum of the photon is:

$$p_0 = m_E C$$
$$=3.874\times10^{-36} \times 3\times10^{8}=1.162\times10^{-27}\ kg\cdot m\cdot s^{-1}$$

As shown in Figure 4.1, photons pass through the sun along the x-axis direction, and the vertical distance from the light to the sun's center is $R = R_0$. The light is symmetric on the left and right sides of the x-axis. First, we only consider that the photons are in the right half of the x-axis, x is from 0 to L_x, and we set to $L_x = 20R$.

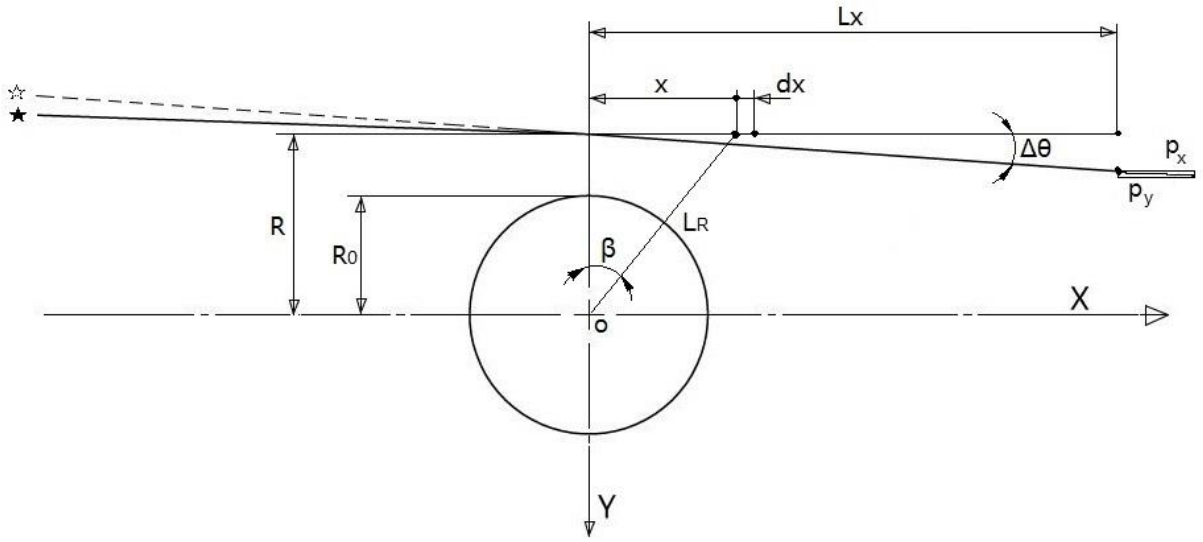

Figure 4.1 Deflection angle of light

When the photon is located at x in the x-axis, the distance between the photon and the sun center is:

$$L_R = (R^2 + x^2)^{1/2}$$

Then, $\cos\beta = R/L_R$

$$\cos\beta = R / (R^2 + x^2)^{1/2}$$

According to Formula (4-2), the photon is subjected to the general gravitational force of the sun:

$$F = G M_E m_E / L_R^{\,2}$$
$$= G M_E m_E / (R^2 + x^2)$$

The component force of the general gravitation F along the y-axis direction is:

$$F_y = F \cos\beta$$
$$= (G M_E m_E / (R^2 + x^2))(R / (R^2 + x^2)^{1/2})$$

$$F_y = G M_E m_E R / (R^2 + x^2)^{3/2}$$

When photons move from 0 to L_X along the x-axis, the momentum increase of photons along the y-axis direction p_{yh} is the integration of the general gravitational force F_y with time, i.e.,

$$p_{yh} = \int_0^{Lx} F_y \, dt$$

where dt = dx/C. Then,

$$p_{yh} = \int_0^{Lx} F_y \, dx/C$$

$$= \int_0^{Lx} (G M_E m_E R / (R^2+x^2)^{3/2}) (dx/C)$$

$$p_{yh} = (G M_E m_E R/C) \int_0^{Lx} \frac{1}{(R^2+x^2)^{3/2}} dx$$

We let the momentum proportional coefficient be:

$P_k = G M_E m_E R/C$

The momentum integral part is:

$$P_I = \int_0^{Lx} \frac{1}{(R^2+x^2)^{3/2}} dx$$

Then, $p_{yh} = P_k P_I$

Pyh is the momentum increase of the photon along the y-axis on the right half of the x-axis. Since the x-axis is symmetrical, when the photon moves from - L_X to L_X, the total momentum of the photon along the y-axis direction is:

$p_y = 2 p_{yh}$

The momentum of the photon along the x-axis is the initial momentum of the photon p_0:

$p_x = p_0$

Under the gravitational action of the sun, the velocity of the photon remains unchanged, but the momentum and general mass of the photon change. The velocity direction of the photon is deflected, and the deflection angle is Δθ.

$\tan\Delta\theta = p_y / p_x$

$\Delta\theta = \tanh（p_y / p_x）$

Based on the above analysis, we use a computer software for numerical processing. The following is the computer program code for calculating the photon deflection angle.

```
//#################################################################//
//#                        Deflection angle of light                #//
//#             based on the law of general gravitation             #//
//#################################################################//
private void btnRun_Click(object sender, EventArgs e)
{
    double m_dblG = 6.67E-11;          //define and init gravitational constant G
    double m_dblC = 3.0E8;             //define and init light speed C
    double m_dblR0 = 695500000.0;      //define and init sun's radius R0
    double m_dblME = 1.989E30;         //define and init sun's general mess ME
    double m_dblm = 3.874E-36;         //define and init photon's general mess mE
```

```
double m_dblpx = 1.162E-27; //define and init photon momentum    along the x-axis

double m_dblR = 0.0;              //define the distance from the light to the sun's center R
double m_dblLx = 0;               //define the length of x-axis
double m_dbldx = 0;               //define integrated differential element dx at x-axis
ulong m_uNCount = 0;              //define the count of differential elements
double m_dblPk = 0.0;             //define the momentum proportional coefficient Pk
double m_dblPI = 0.0;            //define the momentum integral part PI
double m_dblpy = 0.0;             //define the momentum the photon along the y-axis
double m_dblAngle = 0.0;         //define the deflection angle of light

//---------------------------------
ulong i = 0;
ulong j = 0;
string strTemp = "";
double dblTemp = 0.0;

double dbldPI = 0.0;                 //define the differential element dbldPI
double dblx = 0.0;                   //define x value at x-axis
double dblRx = 0.0;                   //define dblRx =（R^2 + x^2）^3/2

//---------------------------------
strTemp = txtR.Text.Trim();
m_dblR = Convert.ToDouble(strTemp);
m_dblR = m_dblR * m_dblR0;         //Init the distance from the light to the sun's center
strTemp = txtLx.Text.Trim(); ;
m_dblLx = Convert.ToDouble(strTemp);
m_dblLx = m_dblLx * m_dblR;                    //Init the length of x-axis

strTemp = txtdx.Text.Trim(); ;
m_dbldx = Convert.ToDouble(strTemp);         //Init differential element dx at x-axis

double dblnCount = m_dblLx / m_dbldx;
m_uNCount = Convert.ToUInt64(dblnCount); //Init the count of differential elements
strTemp = Convert.ToString(m_uNCount);
txtn.Text = strTemp;

m_dblPk =(m_dblG * m_dblME * m_dblm * m_dblR);
m_dblPk = m_dblPk / m_dblC;               //Init the momentum proportional coefficient Pk
strTemp = Convert.ToString(m_dblPk);
txtPk.Text = strTemp;

//============================================================
//calculte m_dblPI: dx/（R^2 + x^2）^3/2, (dblRx =（R^2 + x^2）^3/2)
for (i = 0; i <= m_uNCount; i++)
{
      dblx = i * m_dbldx;                              //calculate x value at x-axis
      dblRx = dblx * dblx + m_dblR * m_dblR;
      dblRx = Math.Pow(dblRx, 1.50);                 //calculate dblRx =（R^2 + x^2）^3/2

      dbldPI = m_dbldx / dblRx;                      //calculte the differential element dbldPI
      m_dblPI = m_dblPI + dbldPI;                     //calculte the current m_dblPI
```

```
            j++;
            if (j >= 1000)
            {
                strTemp = Convert.ToString(m_dblPI);
                txtPI.Text = strTemp;
                Application.DoEvents();                    //show the current results
                j = 0;
            }

        }//end for

        //=========================================================
        //show the results
        strTemp = Convert.ToString(m_dblPI);
        txtPI.Text = strTemp;

        m_dblpy = m_dblPk * m_dblPI;
        m_dblpy = 2 * m_dblpy;                          //the photon momentum along the y-axis
        strTemp = Convert.ToString(m_dblpy);
        txtPy.Text = strTemp;

        dblTemp = m_dblpy / m_dblpx;
        m_dblAngle = Math.Tanh(dblTemp);
        m_dblAngle = m_dblAngle * 180 / 3.14159;
        m_dblAngle = m_dblAngle * 3600.0;          //deflection angle of light
        strTemp = Convert.ToString(m_dblAngle);
        txtAngle.Text = strTemp;

    } //end
```

Figure 4.2 shows the running interface and results of the program above.

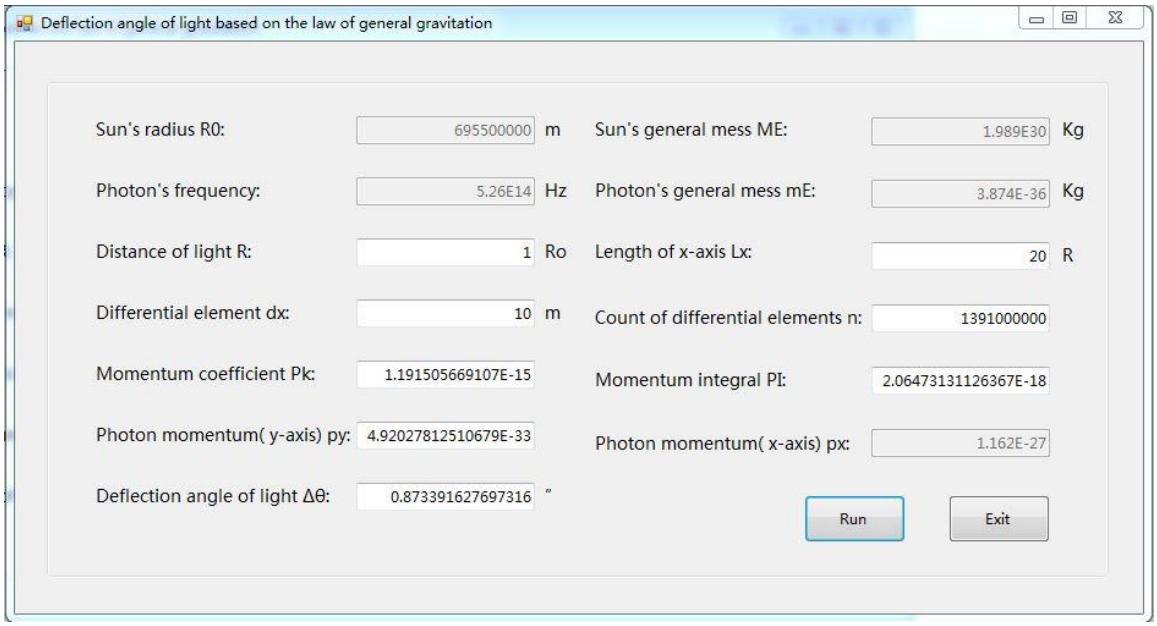

Figure 4.2 Program interface of the deflection angle of light

The sun's radius is R_0 = 695,500,000 m, and its general mass is $M_E = 1.989 \times 10^{30}$ kg. The photon frequency is γ= 5.26×10^{14} Hz, and its general mass is $m_E = 3.874 \times 10^{-36}$ kg. When the light passes through the sun, we let R = R_0, L_X = 20R and the integrated differential element dx = 10 m on the x-axis. With computer numerical processing and calculation, the following is obtained:

Momentum proportional coefficient value:

$P_k = 1.192 \times 10^{-15}$

Momentum integral partial value:

$P_I = 2.065 \times 10^{-18}$

Momentum of the photon along the y-axis

$p_y = 4.920 \times 10^{-33}$ kg·m·s^{-1}

Momentum of the photon along the x-axis:

$p_x = 1.162 \times 10^{-27}$ kg·m·s^{-1}

Deflection angle of the photon:

$\Delta\theta = 0.8734''$

In 1915, Einstein calculated that the perihelion deflection angle of light was 1.75″ based on general relativity.

On May 29, 1919,the British scientist Eddington organized two teams on the west coast of Africa to photograph and observe the total solar eclipse to verify Einstein's theory of light deflection. The deflection angles obtained by the two teams were 1.98″ and 1.61″, respectively. The observation results were in good agreement with Einstein's theoretical calculations, and the concept of general relativity began to be accepted by people.

There is a large error between Eddington's observation results and the deflection angle of 0.8727″ calculated by the law of general gravitation. In fact, when light passes through the sun, the influence of the sun's atmosphere on the light needs to be considered.

As shown in Figure 4.3, to make a rough estimate of the impact of the sun's atmosphere on the light, the radius of the outer periphery of the sun's atmosphere is taken as 20 times the radius of the sun. It is assumed that the atmospheric pressure in the sun's atmosphere is constant, which is the standard atmospheric pressure of the earth. Referring to the atmospheric environment of the earth, the refractive index n_2 of light under standard atmospheric pressure is 1.00029, and the refractive index n_1 in vacuum is 1.00000.

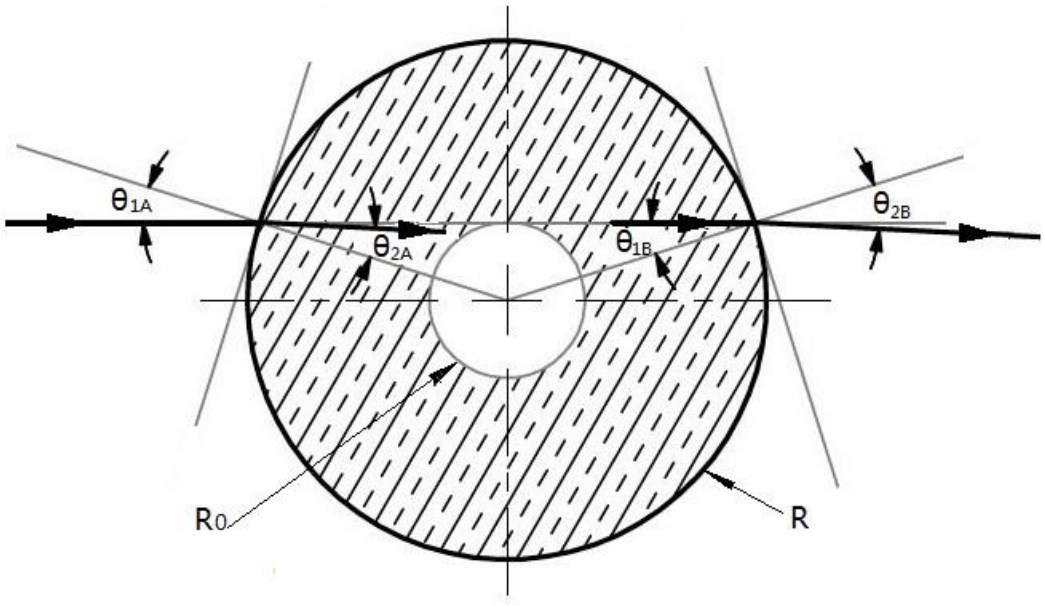

Figure 4.3 Deflection angle of light under the sun's atmosphere

Figure 4.3 shows the refraction equation of light propagation.

$$n_1 \sin\theta_{1A} = n_2 \sin\theta_{2A} \qquad (4\text{-}10)$$

where $\sin\theta_{1A} = R_0/(20R_0) = 0.05$

Then $\theta_{1A} = 0.050021$ arc

We substitute $n_1 = 0.00000$, $n_2 = 1.00029$, and $\sin\theta_{1A} = 0.05$ into Formula (4-10) to obtain:

$$\sin\theta_{2A} = 0.05/1.00029 = 0.0499855$$

Then, $\theta_{2A} = 0.050006$ arc

When the light enters the sun's atmosphere from the vacuum, the deflection angle of the light is:

$$\theta_{1A} - \theta_{2A} = 0.050021 - 0.050006 = -0.000015 \text{ arc}$$

That is, $\theta_{1A} - \theta_{2A} = 3.029''$

Similarly, when light from the sun's atmosphere is emitted to the vacuum, the deflection angle of the light is equal to that when the light enters the sun's atmosphere from the vacuum. Thus, the total deflection angle of the light from by the sun's atmosphere is:

$$\Delta\theta_{Air} = 2 \times 3.029 = 6.058''$$

The deflection angle $\Delta\theta_{Air}$ is much larger than the deflection angle obtained by Eddington's observation experiment. Therefore, Eddington's observation experiment on May 29, 1919,

did not prove the theoretical prediction of Einstein's general relativity on the perihelion deflection angle of light. The observation experiment on the deflection angle of light passing through the sun must eliminate the influence of the sun's atmosphere.

4.2.2 The deflection angle of light far away from the sun's atmosphere

To eliminate the influence of the sun's atmosphere on the deflection angle of light, the light must pass the sun far away from the sun's atmosphere. Thus, referring to Figure 4.1, we let the distance between the light and sun's center be R = 200R_0. Figure 4.4 shows the running interface and results of the computer program.

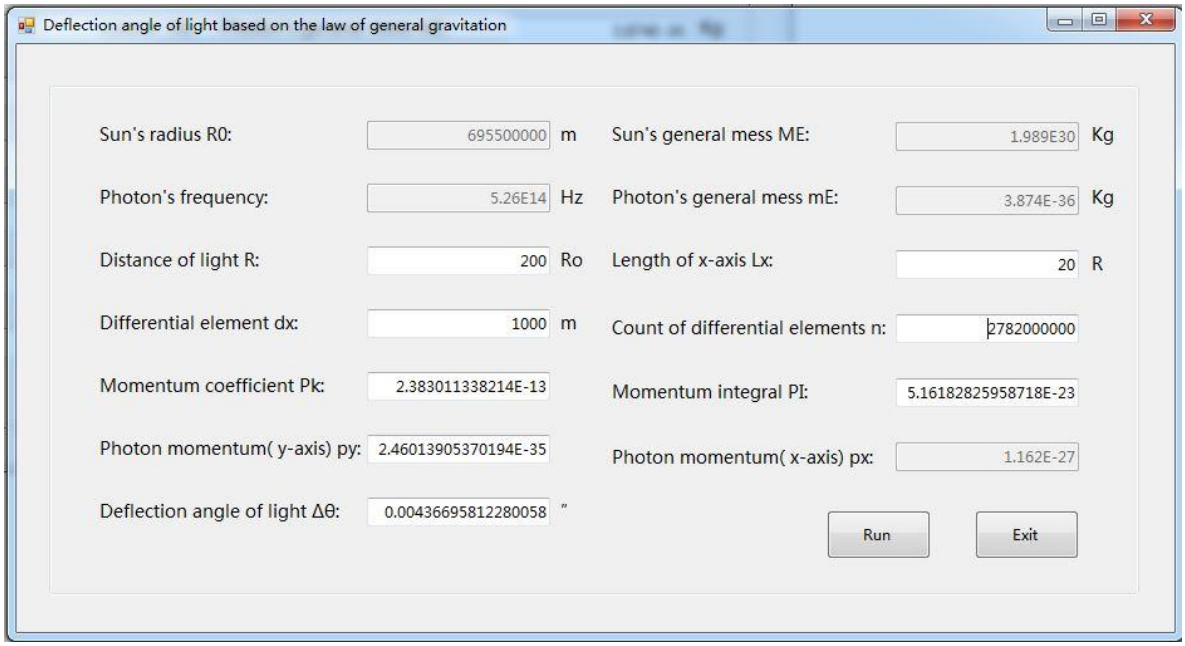

Figure 4.4 Deflection angle of light far away from the sun's atmosphere

With the results of the computer program, when R = 200R_0, the deflection angle of light Δθ is 0.004367″. The Purple Mountain Observatory, Chinese Academy of Sciences, leads in observing and measuring the light deflection angles between galaxies, and its measurement accuracy can reach 0.000001″.

Table 4-1 shows the deflection angle values calculated by the computer program when R is 20R_0, 40R_0, 60R_0, 80R_0, 100R_0, 120R_0, 140R_0, 160R_0, 180R_0 and 200R_0.

Table 4-1 Deflection angle of light far from the sun's atmosphere

R	Pk	PI	p_y	p_x	Δθ(″)
20R_0	2.383E-14	5.162E-21	2.460E-34	1.162E-27	0.043670
40R_0	4.766E-14	1.290E-21	1.230E-34	1.162E-27	0.021835
60R_0	7.149E-14	5.735E-22	8.200E-35	1.162E-27	0.014557

$80R_0$	9.532E-14	3.226E-22	6.150E-35	1.162E-27	0.010917
$100R_0$	1.192E-13	2.065E-22	4.920E-35	1.162E-27	0.008734
$120R_0$	1.430E-13	1.434E-22	4.100E-35	1.162E-27	0.007278
$140R_0$	1.668E-13	1.053E-22	3.145E-35	1.162E-27	0.006239
$160R_0$	1.906E-13	8.065E-23	3.075E-35	1.162E-27	0.005459
$180R_0$	2.145E-13	6.373E-23	2.733E-35	1.162E-27	0.004852
$200R_0$	2.383E-13	5.162E-23	2.460E-35	1.162E-27	0.004367

5. Standard cosmology and its problems

Cosmology is a branch of astrophysics that studies the origin, evolution and ending of the universe. The big bang cosmology is strongly supported by the Hubble expansion, light element abundances and cosmic microwave background radiation. It has become standard cosmology and is accepted by most physicists. However, standard cosmology is facing many challenges, such as accelerating cosmic expansion, dark matter and dark energy.

5.1 Space structure of the universe

Based on Axiom 2.1, physical absolute space is a three-dimensional infinite linear space, which has no directionality and is uniform and isotropic everywhere. Physical absolute space is absolutely invariable and static and has nothing to do with anything outside. Physical absolute space contains all physical matters that exist. Physical absolute space itself has nothing to do with any specific physical matter and energy. It is an absolute vacuum space and can be called the void space.

In the past half century, with the expansion and deepening of our exploration of the universe, the physical absolute space (void space) can be used to better understand the creation, change and extinction of the universe. There is no field matter and no energy in the void space. The void space exists independently of the universe. Before the big bang, the void space already existed. During the evolution of the universe, the void space and the universe exist together. Even after the demise of the universe, the void space still exists. The universe is synonymous to a changing water drop in the void space.

The universe was born tens of billions of years ago. When the big bang occurred at a certain point in the void space, the field matter in the universe radiated energy to the void space at the field speed C. That is, the universe expands uniformly around the void space at the field speed C. Figure 5.1 shows the space structure picture of the universe based on modern

observations.

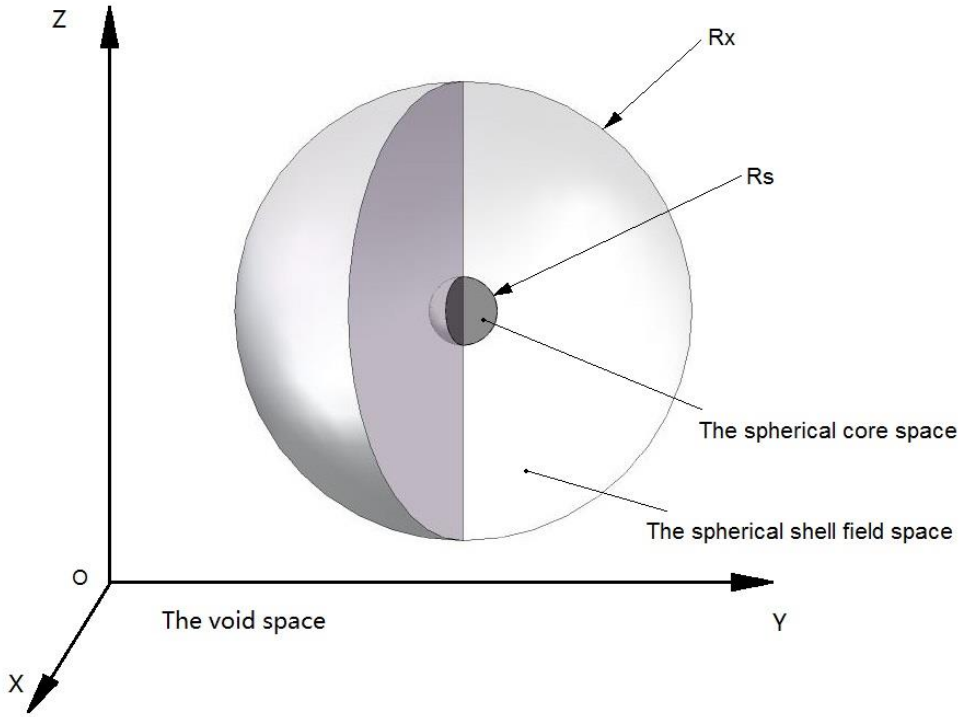

Figure 5.1 Space structure picture of the universe

As shown in Figure 5.1, the universe is a sphere suspended in the void space. The center of the sphere is the origin of the big bang. The universe is composed of **the spherical core space and the spherical shell field space.**

The spherical core space is centered on the origin point of the big bang. Based on modern cosmic observations, its diameter D_S is 10 billion light-years to 20 billion light-years. Through estimations, the diameter of the spherical core space is:

D_S=15 billion light-years

Its radius is:

R_S=7.5 billion light-years

Additionally, based on modern cosmic observation, as a prediction value, the maximum relative retrograde velocity between two stars is:

V_S= 0.30C

The age of the universe is:

$T_S = D_S / V_S$

$= 15 / 0.3$

T_S = 50 billion light-years

Thus, the outer diameter of the spherical shell field space is:

D_X=100 billion light-years

Its radius is:

R_X=50 billion light-years

The spherical core space is composed of solid matter and field matter, and the spherical shell field space is completely composed of the field matter. The space outside the spherical shell field space is void space. Since the birth of the big bang, the expansion speed to the void space has been constant at the field speed C.

5.2 Dark energy and dark matter

Physical matter is divided into solid matter and field matter, and physical matter is an objective existence of energy. Based on the energy, we have a general mass definition of physical matter. For any physical matter with the energy E, its general mass is defined as:

$m_E = E/C^2$

General mass is the fundamental measurement of energy for both solid matter and field matter. In an independent physical system, energy is conserved, and the general mass must also be conserved.

From the above analysis, it can be concluded that there are no dark energy and dark matter in the universe, the so-called dark energy is the energy of field matter, and the so-called dark matter is the general mass of field matter.

Based on cosmic observations, the temperature is 2.7 K at a cosmic microwave background radiation of 13.7 billion light-years. According to the Stefan-Boltzmann law of blackbody radiation, the radiation power per square meter is

$p_1=\sigma T^4$ w•m^{-2} J•s^{-1}•m^{-2}

We substitute σ=5.67x10-8 J•S^{-1}•m^{-2}•K^{-4}, T=2.7K into the above formula and obtain:

$p_1=3.01x10^{-6}$ J•s^{-1}•m^{-2}

Since the Earth is located in the spherical core space, the above 2.7 K cosmic radiation is observed from the opposite direction of radiation emission, and the real radiation power per square meter should be greater than the above calculated value. p_1 should be multiplied by a scale coefficient K_S, which can be measured experimentally. Here, it is estimated that the scale coefficient K_S is 1000.0; thus, p_1 is:

$p_1 = 3.01x10^{-3}$ J•s^{-1}•m^{-2}

Since the velocity of the cosmic radiation C = $2.9979x10^8$ m•s^{-1}, the energy density of the radiation per cubic meter is:

$E_1= p_1/C$

$$E_1=1.004x10^{-11}\ J•m^{-3}$$

The above radiation energy density E_1 is estimated as the average energy density of the field matter in all cosmic radiation. The universe has a radius of R_X = 50 billion light-years, and its spherical volume is:

$$V_X = （4\pi/3）R_X^3$$
$$= （4\pi/3）（50x10^9 \times 9.46x10^{15}）^3$$

$$V_X = 4.431x10^{80}\ m^3$$

The total energy of the field matter in the universe is:

$$E_X = E_1 V_X$$
$$= （1.004x10^{-11}）（4.431x10^{80}）$$

$$E_X = 4.449x10^{69}\ J$$

The total general mass of the field matter in the universe is:

$$M_X = E_X / C^2$$

$$M_X = 0.494 \times 10^{53}\ kg$$

Based on the above analysis and calculation, the total energy of the field matter is the so-called dark energy, and the total general mass of the field matter is the so-called dark matter. The estimated values of the general mass and energy of the field matter are approximately consistent with the modern cosmic observation data.

5.2 Cosmic accelerating expansion

Figure 5.1 shows the space structure picture of the universe. During the birth and evolution of the universe, the field matter in the universe radiated energy to the void space at the field speed C. That is, the universe expands uniformly around the void space at the field speed C.

During the evolution of the universe, the solid matter in its spherical core space is constantly transformed into field matter and radiates into the spherical shell field space. Thus, the general gravitational force from the spherical core space, which attracts galaxies together, decreases; and the general gravitational force from the spherical shell field space, which separates galaxies from each other, increases. The relative retrograde speed between galaxies is increasing, that is, the expansion between galaxies is accelerating.

6. Conclusion

In this paper, Newton's dialectical space-time concept is discussed and developed. Space and time are universal properties of physical matter. Absolute space-time reflects the universality, consistency and stability of physical matter, while relative space-time reflects the particularity, diversity and movement characteristics of specific physical matter.

Physical matter is an objective existence with energy. Physical matter can be further divided into solid matter and field matter. Solid matter includes various forms of macro-objects and all micro-particles and elementary particles . The speed of solid matter is less than C. There are only four kinds of field matter: electric field, magnetic field, light field and gravitational field. Field matter can only move in physical absolute space, so its speed is a constant C, which is reasonable and self-consistent. Energy is the essence of physical matter and field matter.

Based on the energy and Einstein mass energy equation, we introduce and define the general mass. For any physical matter with an energy E, its general mass m_E is defined as:

$$m_E = E/C^2$$

The definition and introduction of general mass, combined with the momentum theorem, extends Newton's classical dynamics from solid matter to field matter, which replaces Einstein's special relativity.

The definition and introduction of general mass expands Newton's classical law of gravitation to the law of general gravitation, which replaces Einstein's general relativity.

In this paper, a verification experiment of the law of general gravitation is also presented. When the light passes far away from the sun and $R=200R_0$ (R_0 is the radius of the sun), according to the law of general gravitation, the deflection angle of light $\Delta\theta$ is 0.004367″.

Regarding the many problems of standard cosmology, this paper reveals that there are no dark energy and dark matter in the universe, the so-called dark energy is the energy of field matter, and the so-called dark matter is the general mass of field matter.

The universe expands uniformly around the void space at the field speed C. As the solid matter in the spherical core space decreases, and the field matter in the spherical shell field space increases, the relative retrograde speed between galaxies increase, that is, the expansion of galaxies is accelerating.

Physical matter is an objective existence with energy. Energy is the essence of physical matter, and it is the only essence of physical matter. Therefore, physical matter and energy are completely equivalent, and general mass is the measurement of energy. Inertia, gravitation, and space and motion characteristics are the universal fundamental properties of energy; that is, any physical matter or energy has inertia, gravitation, space and motion characteristics.

Inertial mass is the measurement of the energy inertial property, and gravitational mass is the measurement of the energy gravitational property. The gravitational constant G causes the gravitational mass and inertial mass to be equal, and the values of gravitational mass and

inertial mass are equal to those of the general mass. However, inertial and gravitational properties are different universal properties of energy, so inertial mass and gravitational mass are two different physical measures. In the momentum theorem, the general mass represents the inertial mass of energy. In the law of general gravitation, the general mass represents the gravitational mass of energy.

Any physical matter or energy has the property of space and the property of moving and changing in space. Length is the measurement of the energy space property, and time and temperature are the measurement of the properties of energy moving and changing in space. Time is not a property of energy.

Mass, length, time and temperature are the fundamental measurements of physical matter or energy.

Author: Hongyuan Ye hongyy@buaa.edu.cn
Yangtze Delta Region Lab of Innovation (Jiashan), China

References：

[1] Hongyuan Ye, Maxwell's Equations and the Principals of Electromagnetism (3rd edition), https://mp.weixin.qq.com/s/LChyTDrZNfwLTJLoSu6Jmw 2022-06-02

[2] Newton, Mathematical Principles of Natural Philosophy, 1st Edition, Peking University Press, Beijing, 2006

[3] Einstein, A., Relativity, the Special and the General Theory, 1st Edition, Peking University Press, Beijing, 2006

[4] Wangjun Feng, Jianfeng Dai et al., College Physics, 2nd Edition, Science Press, Beijing, 2021

[5] Richard P. Feynman et al., The Feynman Lectures on Physics, The New Millennium Edition, Shanghai Science & Technical Publishers, Shanghai, 2020

[6] Guosheng Wu, The Journey of Science, 4th Edition, Changsha, Hunan Science and Technology Press, 2018

[7]Zexian Cao，The things that gravity bends light, https://mp.weixin.qq.com/s/9wbELlSz8O4MUvBNO3Sd9w 2019-04-12